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VOLUME 17, NUMBER 4
APRIL 1984

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A monthly publication of the Geological Survey
U.S. Department of the Interior

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The Secretary of the Interior has determined that the publication of the periodical is necessary in the transaction of the public business required by law of this Department. Use of funds for printing this periodical has been approved by the Office of Management and Budget through September 30, 1985.

As the Nation's principal conservation agency, the Department of the Interior has responsibility for most of our nationally owned public lands and natural resources. This includes fostering the wisest use of our land and water resources, protecting our fish and wildlife, preserving the environmental and cultural values of our national parks and historical places, and providing for the enjoyment of life through outdoor recreation. The Department assesses our energy and mineral resources and works to assure that their development is in the best interests of all our people. The Department also has a major responsibility for American Indian reservation communities and for people who live in Island Territories under U.S. administration.

PREFACE

Selected Water Resources Abstracts, a monthly journal, includes abstracts of current and earlier pertinent monographs, journal articles, reports, and other publication formats. These documents cover water resources as treated in the life, physical, and social sciences and the related engineering and legal aspects of the characteristics, supply condition, conservation, control, use, or management of water resources. Each abstract includes a full bibliographic citation and a set of descriptors which are listed in the **Water Resources Thesaurus.** The abstract entries are classified into 10 fields and 60 groups similar to the water resources research categories established by the Committee on Water Resources Research of the then Federal Council for Science and Technology.

Selected Water Resources Abstracts is designed to serve the scientific and technical information needs of scientitsts, engineers, and managers as one of several services of the Water Resources Scientific Information Center. The cumulative SWRA file from 1968 and monthly updates are available also in magnetic tape through lease from NTIS.

THE WATER RESOURCES SCIENTIFIC INFORMATION CENTER DOES NOT PROVIDE COPIES OF DOCUMENTS ABSTRACTED IN THIS JOURNAL. Sufficient bibliographic information is given to enable readers to order the desired documents from local libraries or other sources.

Comments and suggestions concerning the contents and arrangement of this bulletin are welcome.

Water Resources Scientific
Information Center
U.S. Geological Survey, MS 421
Reston, VA 22092

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Includes the following Groups: General; Precipitation; Snow, Ice, and Frost; Evaporation and Transpiration; Streamflow and Runoff; Groundwater; Water in Soils; Lakes; Water in Plants; Erosion and Sedimentation; Chemical Processes; Estuaries.

03 WATER SUPPLY AUGMENTATION AND CONSERVATION

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04 WATER QUANTITY MANAGEMENT AND CONTROL

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05 WATER QUALITY MANAGEMENT AND PROTECTION

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06 WATER RESOURCES PLANNING

Includes the following Groups: Techniques of Planning; Evaluation Process; Cost Allocation, Cost Sharing, Pricing/Repayment; Water Demand; Water Law and Institutions; Nonstructural Alternatives; Ecologic Impact of Water Development.

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SELECTED WATER RESOURCES ABSTRACTS

1. NATURE OF WATER

1B. Aqueous Solutions and Suspensions

ADSORPTION OF LEAD ON THE SUSPENDED PARTICLES OF RIVER WATER,
Al-Najah Univ., Nablus (Israel). Dept. of Chemistry.
R. Salim.
Water Research, Vol. 17, No. 4, p 423-429, April, 1983. 8 Fig, 2 Tab, 25 Ref.

Descriptors: *Lead, *Suspended solids, *Adsorption, Organic matter, Heavy metals, Particle size.

The effects of the chemical composition and particle size, of suspended particles in river water, on the adsorption of lead onto these particles have been studied. Lead has been determined using the conventional method of anodic stripping voltammetry. Particle sizes have been determined using the Coulter Counter. The organic matter content of the suspended particles has been found responsible for most of the lead adsorbed onto these particles. An attempt has been made to quantify the relationship between the particle size of suspended particles and the amount of lead adsorbed onto these particles. The shape of the calibration graphs of lead from solutions in river water has been explained with reference to the adsorption of lead on suspended particles. (Author's abstract)
W84-01273

2. WATER CYCLE

2A. General

EFFECTS OF BIOCLIMATE AND SOIL USE ON WATER BUDGET TERMS IN WEST AFRICA (INFLUENCE DU BIOCLIMAT ET DE L'AMENAGEMENT DES SOLS SUR LES ELEMENTS DU BILAN HYDRIQUE EN AFRIQUE DE L'OUEST),
Office de la Recherche Scientifique et Technique Outre-Mer, Paris (France).
E. Roose, F. Lelong, and J. Colombani.
Hydrological Sciences Journal, Vol. 28, No. 2, p 283-309, June, 1983. 6 Fig, 9 Tab, 54 Ref.

Descriptors: *Hydrologic budget, *Vegetation, *Cultivation, Runoff, Climate, Drainage, Soil type, Soil water, Evapotranspiration, West Africa.

Comparative water budgets have been established by measurement (rainfall, runoff, soil moisture) and calculation (evapotranspiration, drainage) on six experimental plots in West Africa throughout a bioclimatic sequence from the lower Ivory Coast to central Upper Volta. These budgets show the variations of water budget terms with bioclimate, soil use and pedological characteristics. In non-cultivated plots (natural vegetation) the runoff term is low whatever the vegetation (1%-2% of annual rainfall). Deep drainage is near zero when annual rainfall is less than 900-1000 mm (equatorial areas) and less than 700-800 mm (tropical areas). In cultivated plots, runoff increases greatly but total flow (runoff + deep drainage) does not necessarily increase. Thick soils, with important water storage support increased evapotranspiration at the expense of drainage. (Author's abstract)
W84-01104

WATER AND NITRATE-NITROGEN LOSSES FROM A SMALL, UPLAND, COASTAL PLAIN WATERSHED,
Agricultural Research Service, Tifton, GA. Southeast Watershed Research Center.
R. K. Hubbard, and J. M. Sheridan.
Journal of Environmental Quality, Vol. 12, No. 2, p 291-295, April-June, 1983. 4 Fig, 2 Tab, 13 Ref.

Descriptors: *Surface runoff, *Storm seepage, *Nitrates, Seasonal variation, Mathematical studies, Climate, Water pollution sources, Prediction, Small watersheds, Coastal plain.

Surface runoff (SRO) and shallow-subsurface flow (SSF) from a small, upland, Coastal Plain watershed underlain by plinthite were monitored for a 10-yr period. Samples collected during surface runoff and subsurface-flow events were analyzed for NO3-N. The major water runoff loss from the system was found to be subsurface flow, accounting for 79% of total runoff loss, which occurred primarily from December through May. Nitrate-N concentrations in surface runoff and subsurface flow were relatively uniform over the period, averaging 0.47 and 8.75 mg/L, respectively. The combination of high volume of subsurface flow and its relatively high NO3-N content, resulted in 99% of total NO3-N loss via subsurface flow. Predictive equations for monthly surface and subsurface water runoff losses from this watershed were developed using multiple linear regression. The equations contain seasonal and climatic parameters, including pan evaporation. Tests of the equations with observed results gave significant ($P < or = 0.01$) correlation coefficients, r, of 0.82 and 0.85 for surface runoff and subsurface flow, respectively. Mean surface and subsurface NO3-N concentrations were multiplied by predicted monthly flows to compute predicted monthy NO3-N losses. Comparison of predicted and actual monthly NO3-N losses gave significant ($P < or = 0.01$) correlation coefficients, r, of 0.59 and 0.86 for surface and subsurface flows, respectively. The good fit of predicted and observed results can be partially attributed to the seasonal and climatic data base collected over a relatively long period of 10 yr. (Author's abstract)
W84-01188

HYDROLOGY OF THE JORDAN TRIBUTARIES (ISRAEL): HYDROGRAPHIC AND ISOTOPIC INVESTIGATION,
Weizmann Inst. of Science, Rehovoth (Israel). Dept. of Isotope Research.
B. Simpson, and I. Carmi.
Journal of Hydrology, Vol. 62, No. 1-4, p 235-242, April, 1983. 9 Fig, 1 Tab, 24 Ref.

Descriptors: *Geohydrology, *Isotope studies, *Groundwater movement, *Interflow, Tributaries, Jordan River, Oxygen isotopes, Tritium, Hydrograph analysis, Groundwater reservoirs, Rainfall, Springs, Catchment areas, Flow discharge.

Nahal Dan, Nahal Snir and Nahal Hermon are the three principal tributaries of the Jordan River. All three are spring-fed and appear to derive their discharges from the same regional groundwater aquifer. The behavior of this aquifer is examined by hydrograph separation and multivariate time-series analysis of discharge and rainfall records, and by investigation of O18 and tritium records. Hydrograph separation gives base-flow recession constants of 11-20 months and in addition Nahal Snir and Nahal Hermon show an interflow recession of about 1 month. The dual reservoir system for these two tributaries is confirmed by time-series analysis. O18 data distinguish the different catchments for the springs and support the idea that interflow occurs in the near-surface part of the regional groundwater reservoir. Tritium data illustrate the inhomogeneity of the karstic reservoir. Assuming well-mixed conditions, the difference in behavior between tritium records for rainfall and the tributaries is used to estimate the age distribution of water in the reservoir. At any time 50% of the storage is less than 1 yr old and 90% is less than 3 yr old. (Author's abstract)
W84-01223

DESIGN AND CONSTRUCTION OF THE THAMES BARRIER COFFERDAMS,
J. R. Grice, and E. A. Hepplewhite.
Proceedings of the Institution of Civil Engineers, Vol. 74, p 191-224, May, 1983. 1 Tab, 23 Fig, 4 Ref.

Descriptors: *Cofferdams, *Flood control Thames Barrier, England, Design criteria, Construction, Excavation, Underwater, Piers, Abutments, River beds.

Heavy cofferdams were required to facilitate construction in the dry of the piers and abutments of the Thames Barrier at Woolwich (England) which is a flood defense barrier intended to protect London from flooding. The civil works were carried out in two main phases and different basic cofferdam designs were adopted for the two phases. In addition to the effects of differential soil and water levels on either side of the cofferdam walls, the design took into account surcharge of the river bed by sand-filled fairing cells located close to the cofferdam ends, and possible lateral loading transferred through the soil from adjacent fender structures. The design allowed for the excavation and the placing of the concrete base plug being carried out underwater, with unbalanced waterloads on the walls prior to dewatering being limited by the use of sluices through the sheet piles near low water level. To minimize interference with working space, no vertical bracing was provided. The larger cofferdams, 29 m deep, had four strutting frames in the phase 1 design, but only one in phase 2. Eleven deep cofferdams were constructed between 1974 and 1980 to enable nine piers and two abutments to be built across the river. (Moore-IVI)
W84-01250

WATER BUDGETS FOR SMALL DIKED MARSHES,
Utah State Univ., Logan. Dept. of Fisheries and Wildlife.
J. A. Kadlec.
Water Resources Bulletin, Vol. 19, No. 2, p 223-229, April, 1983. 1 Fig, 4 Tab, 15 Ref.

Descriptors: *Marshes, *Hydrologic budget, Dikes, Cycling nutrients, Precipitation rate, Hydrologic cycle, Evapotranspiration, Seepage, Water storage, Hydraulic gradient, Permeability coefficient, Manitoba.

This paper reports an analysis of the water budgets of 10 small (5-6 ha) diked areas (cells) within the Delta Marsh in Southcentral Manitoba, Canada. The important terms in the water budget equation in this study were precipitation (P), water pumped in (SWI), evapotranspiration (ET), seepage in (GWI) and out (GWO), and change in storage (delta S). P, SWI and S were measured directly, and the sum of ET and GWO determined by difference. Estimating ET as 0.7 pan evaporation gave a seepage loss of 2.9 mm/day from the most intensively studied cell. Other methods of estimating ET produced estimates of GWO ranging from 2.4 to 3.8 mm/day. Water budgets for less intensively studied cells indicated seepage loss increased as perimeter available for seepage increased, but not proportionately. Efforts to measure seepage directly or estimate it from measured hydraulic gradients and hydraulic conductivity produced estimates much lower than the estimates from the water budget equation. Hydraulic conductivities were very heterogeneous, reflecting the sorting of water deposited sediments. Comparison of the hydraulic conductivities with seepage estimates from the water budget strongly suggests water movement downward as well as laterally from these diked areas. (Author's abstract)
W84-01283

EVALUATIONS OF WATER BALANCE MODELS ON A MIXED CONIFER WATERSHED,
Rocky Mountain Forest and Range Experiment Station, Flagstaff, AZ.
M. B. Baker, Jr., and J. J. Rogers.
Water Resources Research, Vol. 19, No. 2, p 486-492, April, 1983. 1 Fig, 9 Tab, 15 Ref.

Descriptors: *Hydrologic budget, *Mathematical models, *Evapotranspiration, *Streamflow, Forest watersheds, Runoff volume, Zero discharge, Snowmelt, Intermittent streams.

ARZMLT, BURP and ECOWAT, three water balance and yield models of differing degrees of complexity, were evaluated using data from a mixed conifer watershed in east-central Arizona. Statistical tests on simulated monthly flow volumes are provided with a comparison of 5-year mean annual estimates of evapotranspiration and streamflow. ARZMLT accounts for 87% of the variation

in monthly flow but produces the most bias in simulated monthly runoff volume. BURP accounts for 78% of the monthly streamflow variation and produces the least bias in monthly streamflow volume. The greatest problem with BURP is its inability to simulate zero flow events. Statistics for ECOWAT generally lie between those of the other two models. In an area where intermittent streamflow conditions exist and the majority of flow is from snowmelt, ECOWAT can be used without acquiring much additional error. Results from ARZMLT indicate that some structural changes in the model are needed to simulate the prevalent runoff conditions that exist in the southwest. (Moore-IVI)
W84-01349

EVALUATIONS OF WATER BALANCE MODELS ON A MIXED CONIFER WATERSHED,
Rocky Mountain Forest and Range Experiment Station, Flagstaff, AZ.
M. B. Baker, Jr., and J. J. Rogers.
Water Resources Research, Vol. 19, No. 2, p 486-492, April, 1983. 1 Fig, 9 Tab, 15 Ref.

Descriptors: *Hydrologic budget, *Mathematical models, *Evapotranspiration, *Streamflow, Forest watersheds, Runoff volume, Zero discharge, Snowmelt, Intermittent streams.

ARZMLT, BURP and ECOWAT, three water balance and yield models of differing degrees of complexity, were evaluated using data from a mixed conifer watershed in east-central Arizona. Statistical tests on simulated monthly flow volumes are provided with a comparison of 5-year mean annual estimates of evapotranspiration and streamflow. ARZMLT accounts for 87% of the variation in monthly flow but produces the most bias in simulated monthly runoff volume. BURP accounts for 78% of the monthly streamflow variation and produces the least bias in monthly streamflow volume. The greatest problem with BURP is its inability to simulate zero flow events. Statistics for ECOWAT generally lie between those of the other two models. In an area where intermittent streamflow conditions exist and the majority of flow is from snowmelt, ECOWAT can be used without acquiring much additional error. Results from ARZMLT indicate that some structural changes in the model are needed to simulate the prevalent runoff conditions that exist in the southwest. (Moore-IVI)
W84-01350

MODELING THE EFFECTS OF A TIME-DEPENDENT WETTED PERIMETER ON INFILTRATION FROM EPHEMERAL CHANNELS,
Stanford Univ., CA. Dept. of Civil Engineering.
D. L. Freyberg.
Water Resources Research, Vol. 19, No. 2, p 559-566, April, 1983. 12 Fig, 12 Ref. ENG 76-01271.

Descriptors: *Infiltration, *Ephemeral streams, Channel geometry, Mathematical models, Soil water, Hydrographs, Wetted perimeter, Soil water flow, Vertical infiltration.

The effects of a time-dependent wetted perimeter on infiltration from ephemeral stream channel cross sections are explored using a conceptually simple mathematical model. The model is based on the assumptions of vertical soil moisture flow and the validity of the Green-Ampt model for vertical infiltration. By using a simple channel geometry, an analytic solution is found for the case in which the gravitational component of soil moisture flow may be neglected. An efficient, accurate numerical technique provides approximate solutions in the general case. Application of the model demonstrates that cross-sectional infiltration, that is, infiltration per unit length of channel, is a complex function of soil properties, channel geometry, and hydrograph shape. For the channel geometry considered, the direct effects of variable water pressure at the ground surface are overshadowed by the effects of variation in the wetted perimeter, with the result that the temporal variation in infiltration rate is quite unlike that which would be predicted assuming ponded infiltration alone. (Author's abstract)
W84-01357

COUPLED SURFACE WATER AND GROUNDWATER CATCHMENT MODEL,
University Coll., Cardiff (Wales). Dept. of Civil and Structural Engineering.
J. C. Miles, and K. R. Rushton.
Journal of Hydrology, Vol. 62, No. 1-4, p 159-177, April, 1983. 10 Fig, 1 Tab, 19 Ref.

Descriptors: *River basins, *Catchment areas, *Groundwater movement, *Surface flow, Hydrologic models, Mathematical models, Aquifers, Rainfall, Evapotranspiration, Geohydrology.

For river catchments in which there is significant interconnection between aquifers and the river, a thorough understanding of the way in which water is exchanged between the river and the underlying strata is important for resources planning. The formation of a model to represent surface and subsurface flows of water for a catchment in central England is described. A finite-difference model is used to represent groundwater flows in an aquifer with surface water flows being represented by flow balance techniques. Three hydrologically significant land types have been identified in the catchment: aquifer covered by permeable deposits; low-permeability strata covered by permeable deposits; and areas covered by impermeable drift. The model contains three components which correspond to these. The mode has been designed to be used as a tool for determining the long-term environmental effect of abstraction from the catchment. River flows are calculated for over 120 locations within the catchment. The results show that it is possible to formulate a comprehensive model, of a complete catchment, based upon measurable, physical parameters with the inflow of water being calculated solely from rainfall and evapotranspiration estimates. (Moore-IVI)
W84-01398

2B. Precipitation

DAILY PRECIPITATION OCCURRENCES MODELLING WITH MARKOV CHAIN OF SEASONAL ORDER,
National Technical Univ., Athens (Greece). Dept. of Civil Engineering.
M. Mimikou.
Hydrological Sciences Journal, Vol. 28, No. 2, p 221-232, June, 1983. 2 Fig, 3 Tab, 10 Ref.

Descriptors: *Precipitation, *Seasonal distribution, *Model studies, Markov process, Mathematical studies, Storm duration, Altitude.

The seasonality of the Markov chain order for properly modelling daily precipitation occurrences for precipitation stations in Greece is studied. The average seasonal storm duration, being the average seasonal ratio of the number of wet days to the number of storm events and influenced by the meteorology and geography of the station, is proposed as a criterion for determining the proper seasonal Markov order. For the records studied, and on a monthly basis, the latter, minimizing the chain's modelling error, is the closest positive integer to the average storm duration in days reduced by one. Orders greater than 1 are prevalent in wet periods, whereas in dry periods orders of 1 or 0 predominate. The appearance of the period with orders higher than 1 is delayed and its duration decreases towards the east and with decreasing altitude. The monthly sums of wet days are modelled better by a second order autoregressive model than by aggregating daily precipitation occurrences generated from a Markov chain. (Author's abstract)
W84-01099

APPLICATION OF NETWORK DESIGN PROCEDURES FOR REDESIGNING KIZILIRMAK RIVER BASIN RAINGAUGE NETWORK, TURKEY,
Middle East Technical Univ., Ankara (Turkey). Dept. of Civil Engineering.
For primary bibliographic entry see Field 7A.
W84-01100

WEATHER STATION SITING AND CONSUMPTIVE USE ESTIMATES,
Idaho Univ., Kimberly. Twin Falls Research and Extension Center.
R. G. Allen, C. E. Brockway, and J. L. Wright.
Journal of Water Resources Planning and Management, Vol. 109, No. 2, p 134-146, April, 1983. 11 Fig, 5 Tab, 13 Ref.

Descriptors: *Consumptive use, *Site selection, *Weather stations, Irrigation, Evapotranspiration, Air temperature, Vapor pressure, Arid lands, *Idaho.

The environment of a weather station site is important in estimating consumptive use by irrigated crops. Consumptive use may be overestimated when air temperature and vapor pressure data from a weather station with an arid local environment are used without modification. To document the effect of weather station aridity on consumptive use estimates, three sites in irrigated areas and two sites in nonirrigated, and rangeland in southern Idaho were instrumented with weather stations during 1981. Air temperatures were higher and vapor pressures were lower at the arid sites. Use of air temperatures and dewpoint estimates from arid sites caused an overestimation of evapotranspiration, by 17% (210 mm) over the irrigation season. Results indicate the importance of weather site evaluation and adjustment of siting effects and weather before consumptive use estimates are made. A procedure is outlined for adjusting historical temperature data to reflect an irrigated condition. (Author's abstract)
W84-01144

USE OF HIGH HORIZONTAL RESOLUTION SATELLITE TEMPERATURE AND MOISTURE PROFILES TO INITIALIZE A MESOSCALE NUMERICAL WEATHER PREDICTION MODEL - A SEVERE WEATHER EVENT CASE STUDY,
Australian Numerical Meteorology Research Centre, Melbourne.
For primary bibliographic entry see Field 7B.
W84-01168

TIME-EXTRAPOLATED RAINFALL NORMALS FOR CENTRAL EQUATORIAL PACIFIC ISLANDS,
National Weather Service, Washington, DC. Climate Analysis Center.
B. N. Meisner.
Journal of Climate and Applied Meteorology, Vol. 22, No. 3, p 440-446, April, 1983. 3 Fig, 1 Tab, 22 Ref.

Descriptors: *Rainfall distribution, *Precipitation, *Pacific islands, Climatic zones, Ridge regression, Barometric pressure.

Normal annual rainfalls (means and medians) for the period 1910-75 are estimated for islands in the central equatorial Pacific. Ridge regression, with an empirically determined bias constant, is used to establish the relationships among the island rainfalls and those at Fanning, Nauru and Banaba as well as the mean sea level pressure at Darwin. The estimated medians are less than those observed; the estimated means are greater than observed. Since rainfall distributions have large positive skewness, the median is more representative of central tendency, and the difference between the mean and the median is a measure of the variability. These results imply that rainfalls in the central Pacific were smaller and more variable in the earlier part of this century. Variations in the position and intensity of the two major convective bands in the Pacific, the Near Equatorial Convergence Zone and the South Pacific Convergence Zone appear to account for most (88%) of the interannual rainfall variability. Although the interannual rainfall variability is large, the secular variability is not. Most of the adjustments were on the order of 10%, suggesting that even short (20-30 year) data records provide

reasonably accurate estimates of normal rainfalls for these islands. (Author's abstract)
W84-01171

EXPONENTIAL SIZE DISTRIBUTIONS OF RAINDROPS AND VERTICAL AIR MOTIONS DEDUCED FROM VERTICALLY POINTED DOPPLER RADAR DATA USING A NEW METHOD,
Centre de Recherches en Physique de l'Environnement, Issy-les-Moulineaux (France).
D. Hauser, and P. Amayenc.
Journal of Climate and Applied Meteorology, Vol. 22, No. 3, p 407-418, March, 1983. 8 Fig, 3 Tab, 22 Ref.

Descriptors: *Rain, *Radar, Rainfall, Weather, Drop size.

Raindrop-size distributions and vertical air motions are deduced from vertically pointing C-band Doppler radar data by using a new method, the three parameters method, which assumes the raindrop sizes are exponentially distributed. Results gathered in stratiform rain precipitation after the passage of a cold front are presented and compared with those obtained by using the well-know Rogers approach. The new method, which does not a priori require the knowledge of N sub 0 values is capable of detecting spatial and temporal variations much better than the Rogers method. Taking this variability into account allows one to find relationships involving three rainfall parameters with good accuracy. (Moore-IVI)
W84-01172

CHANGES IN THE NATURE OF FLUCTUATIONS OF TEMPERATURE AND LIQUID WATER CONTENT DURING THE LIFETIME OF A LARGE-SCALE STORM,
Air Force Geophysics Lab., Hanscom AFB, MA.
R. M. Dyer, and I. D. Cohen.
Journal of Climate and Applied Meteorology, Vol. 22, No. 3, p 385-393, March, 1983. 11 Fig, 3 Tab, 11 Ref.

Descriptors: *Storms, *Weather, *Cloud physics, Spectral analysis, Temperature, Liquid water content.

The results of a spectral analysis of the horizontal fluctuations in temperature and liquid water content measured by instrumented aircraft at four altitudes daily during four days in the life-cycle of a storm moving eastward across the United States are discussed, along with a synoptic analysis of the storm. The storm itself was typical of the large scale systems travelling across the continent during the winter season. Each stage of the storm (development, maturity, and dissipation) exhibited distinctive spectral characteristics. In addition, the evidence that the age and previous history of the system greatly affect the fluctuation spectra is strong. The results of the study support the thesis of a characteristic spectral signature for cloud systems, as well as for single clouds. This method may be used to determine the present growth stage of a storm system, and its potential for future development. (Author's abstract)
W84-01173

ASSOCIATIONS BETWEEN ANOMALIES OF TEMPERATURE AND PRECIPITATION IN THE UNITED STATES AND WESTERN NORTHERN HEMISPHFRE 700 MB HEIGHT PROFILES,
National Climatic Center, Asheville, NC.
H. F. Diaz, and J. Namias.
Journal of Climate and Applied Meteorology, Vol. 22, No. 3, p 352-363, March, 1983. 7 Fig, 3 Tab, 25 Ref. NOAA/NA81-AA-D-00054, NSF-ATM81-18115.

Descriptors: *Precipitation, *Climatology, *Seasonal distribution, Air temperature, Latitudinal studies, Temperate zone, Midtropospheric height, Weather patterns.

The relationship between anomalous seasonal surface temperature and precipitation in the contiguous United States and concomitant fluctuations of western Northern Hemisphere 700 mb height as a function of latitude are examined. Findings are consistent with other studies dealing with the spatial patterns of midtropospheric teleconnections and their surface manifestations. A strong inverse relationship between temperature in the eastern United States and heights in the western Northern Hemisphere polar regions is present during winter and spring, especially in winter. In summer, the association is positive and is most evident in the southern tier of states. Fewer significant correlations are found between seasonal precipitation and midtropospheric height, with the strongest ones occurring in winter and summer. No correlation coefficient was statistically significant for the autumn season. Where significant, the regional precipitation variance of the other three seasons accounted for by the 700 mb height field varies from 11-44% in winter to 11-30% for spring and summer. Spatial coherence of the correlation pattern is appreciable but is not as strong as for temperature. In winter, during the period 1948-81, the frequency of below-average 700 mb heights has increased in the temperate latitudes of the western Northern Hemisphere. At the same time, a general increase in above normal polar latitude heights has taken place. This in turn has been associated with lower winter temperatures in the eastern United States. (Moore-IVI)
W84-01174

ON THE ANALYSIS OF EXTREME RAINFALLS,
Meteorological Service, Wellington (New Zealand).
K. J. A. Revfeim.
Journal of Hydrology, Vol. 62, No. 1-4, p 107-117, April, 1983. 2 Tab, 8 Ref.

Descriptors: *Rainfall, *Statistical models, *Recurrence time, Rainfall distribution, Return period, Temporal distribution, Rainfall extremes, Model studies, Mathematical models.

Two standard analyses of rainfall records are to obtain the expected maximum amount (depth) within a given time interval or expected recurrence time (return period) of a given rainfall amount. The methods in common practice assume little or nothing about an underlying time-dependent rainfall process. A simple recurrence model which represents the rainfall process in an intuitively realistic manner is developed in this paper. The statistical properties of the model provide small sample estimates of maximum amounts and recurrence times. Anomalies in rainfall analysis based on asymptotic theory do not occur in the recurrence model. (Author's abstract)
W84-01228

ERRORS IN THE THIESSEN TECHNIQUE FOR ESTIMATING AREAL RAIN AMOUNTS USING WEATHER RADAR DATA,
McGill Univ., Montreal (Quebec). Stormy Weather Research Group.
C. Damant, G. L. Austin, A. Bellon, and R. S. Broughton.
Journal of Hydrology, Vol. 62, No. 1-4, p 81-94, April, 1983. 4 Fig, 6 Tab, 21 Ref.

Descriptors: *Rain gages, *Radar, *Rainfall distribution, Thiessen polygon method, Weather data collections, Storms, Watersheds, Yamaska River watershed, Convective precipitation.

High-resolution radar data were used to estimate rainfall accumulation patterns for thirteen summer storms over the Yamaska River watershed. The results were compared with those obtained using the Thiessen polygon method. For any of the storms the error varied from $<8\%$ to $>100\%$ for each size subcatchment. The size of the error depended on the rainfall gradients produced by each storm and not greatly either on the area size or on the number of polygons associated with the area. The average error for all thirteen storms together over each subcatchment size varied between 15% and 84%, whereas the error over the entire watershed for each storm varied between 3% and 69%. The average error for all storms over the whole basin was 19%. It is concluded that for showery rain at least, the errors associated with using gage data are of significant magnitude and that users of streamflow models should be careful in the use of these data for convective showers. This paper also provides a review of some of the problems of estimating the spatial distribution of rain from both radar and raingage data. (McKeon-IVI)
W84-01230

SPATIAL-TEMPORAL MODEL OF STORM RAINFALL,
Leeds Univ. (England). Dept. of Statistics.
R. J. Marshall.
Journal of Hydrology, Vol. 62, No. 1-4, p 53-62, April, 1983. 5 Fig, 5 Ref.

Descriptors: *Rainstorms, *Statistical models, Rainfall distribution, Simulation analysis, Weather patterns, Model studies, Storms, Spatial distribution, Temporal distribution.

A multiple time series model is proposed to describe the spatial and temporal distribution of small-scale rainfall patterns. The model has seven parameters and is characterized by a multiple autoregressive scheme that has the property of its correlation structure being factorized into space-time components. Such a factorization explains the observed correlation structure of 2-min. rainfall of storms recorded by the Cardington and Winchcombe, England networks. The model can also be adapted to simulate within storm sequences or to generate moving storm sequences. (McKeon-IVI)
W84-01231

WEST AFRICAN WATER VAPOR VARIATIONS BETWEEN RECENT CONTRASTING SUBSAHARAN RAINY SEASONS,
Illinois State Water Survey, Champaign. Climatology and Meteorology Section.
P. J. Lamb.
Tellus, Vol. 35A, No. 3, p 198-212, May, 1983. 3 Fig, 5 Tab, 23 Ref.

Descriptors: *Water vapor, *Monsoons, West Africa, Seasonal variation, Drought, Rainfall, Rainy season.

Investigation is made of the interannual and intraseasonal variability of the southwest monsoon layer's thickness and moisture content over West Africa, and its water vapor supply to this region from the tropical Atlantic, for the Subsaharan (10 degrees - 20 degrees N) rainy season of July-September. Results for the very deficient 1968, 1971, and 1972 Subsaharan rainy seasons, whose departures from the 1941-74 mean ranged between -0.78 sigma and -1.39 sigma, are compared with those for the near-average rainy seaons of 1967, 1969, and 1975 (-0.27 sigma to +0.06 sigma). The observational base consists of monthly mean rawinsonde data from West African stations and seasonal estimates of the tropical Atlantic near surface specific humidity field. Subsaharan drought does not appear to be associated with the northward supply of unusually dry surface air to West Africa from the tropical Atlantic. Over West Africa, the magnitude of the vertically integrated monsoon layer advective water vapor flux tends to be proportional to the layer thickness. The extremely poor 1972 Subsaharan rain season (-1.39 sigma) coincided with particularly shallow southwesterly flow across the Gulf of Guinea coast (about 5 degrees N); thicker monsoon layers are found characteristic of the less severe 1968 (-0.78 sigma) and 1971 (-0.88 sigma) droughts. However, the monsoon layer depth here during the non-drought study years does not always exceed that for drought months. The direction of the low level water vapor flux above Dakar, a sensitive Subsaharan location (about 15 degrees N) on the West African coast, shows a stronger tendency to be from north of west during unproductive Subsaharan rainy season (-0.78 sigma to -1.39 sigma) than in near-average ones (-0.27 sigma to +0.06 sigma). This suggest the southwest monsoon does not extend as far north along the West African coast during Subsaharan droughts as in more abundant rainy seasons. In contrast to the foregoing Gulf of Guinea results, the monsoon layer over the interior

of the Subsaharan zone at about 13 degrees N exhibits minimal variability for the drought study years. The better developed nondrought southwesterly flows here tended to be thicker than those characteristic of most drought months. (Author's abstract)
W84-01311

SATELLITE OBSERVATIONS OF THE SOUTHERN HEMISPHERE MONSOON DURING WINTER MONEX,
Australian Numerical Meteorology Research Centre, Melbourne.
J. L. McBride.
Tellus, Vol. 35A, No. 3, p 189-197, May, 1983. 4 Fig, 1 Tab, 30 Ref.

Descriptors: *Monsoons, *Satellite technology, Infrared imagery, Convection, Tropical cyclones, Southern hemisphere.

Time-longitude strips of infrared GMS satellite imagery have been used to study the southern hemisphere summer monsoon during Winter MONEX (International Monsoon Experiment). This representation reveals a sudden monsoon onset in late December characterized by a transition to spatially organized convection. Active and break regions of the monsoon show a strong coherence in time but are very longitudinally dependent. The latitudinal dependence, on the other hand, is quite weak. The dominant spatial scale over which changes in convection take place is of order 35 degrees longitude by 15 degrees latitude. These synoptic scale convective regions can move in either the eastward or west direction. Typical phase speeds of movement range between 3 and 8 degrees longitude per day. Tropical cyclones in the region are revealed to be embedded in the large-scale monsoon circulation. (Author's abstract)
W84-01312

PATTERNS OF INDIA MONSOON RAINFALL ANOMALIES,
Wisconsin Univ.-Madison. Dept. of Meteorology.
S. Hastenrath, and A. Rosen.
Tellus, Vol. 35A, No. 4, p 324-331, August, 1983. 5 Fig, 1 Tab, 26 Ref. ATM76-09784, ATM79-11131.

Descriptors: *Rainfall distribution, *Monsoons, India, Tropical cyclones, Pattern stratification, Spatial distribution, Temporal distribution.

Pattern characteristics of annual rainfall anomalies over India during 1900-72 are studied from precipitation records of 31 regional subdivisions and series of annual cyclone frequency and number of break monsoon days. Methods include spatial correlation, pattern stratification, and principal component and spectral analyses. Pattern stratification with respect to an all-India rainfall index yields largest concordant departures in the Central and Western portions of the country. Pattern stratification with respect to the largest annual frequency of cyclonic storms in the Bay of Bengal and Arabian Sea show large positive rainfall departures over Eastern, Southeastern and Western India, and negative departures in the North and a limited area of the Southwest; for the collective of years with smallest storm frequency a partly inverse rainfall anomaly pattern is obtained. Pattern stratification with respect to the years of most numerous break monsoon days yields deficient rainfall in a large, broadly zonally oriented band across Central India, and positive departures in most other parts of the country. Stratification with respect to the least numerous break monsoon days yields a broadly inverse pattern. The first eight principal component patterns account for 74% of the total variance. The first component resembles the pattern obtained by stratification with respect to the all-India rainfall index, the two time series being highly positively correlated. The third component is approximately inverse to the pattern constructed from stratification with respect to the most numerous break monsoon days, the two time series being negatively correlated. The seventh component is similar to the pattern derived from stratification with respect to the largest frequency of cyclonic storms: this is consistent with the positive correlation between the two time series. No physical significance is apparent for the other principal components. The combination of the various analysis techniques thus serves to identify spatial and temporal pattern characteristics of possible physical significance. (Author's abstract)
W84-01313

A SIMPLIFIED SEMIEMPIRICAL APPROACH TO PROBABILITIES OF EXTREME HYDROLOGIC DROUGHTS,
Auburn Univ., AL. Dept. of Civil Engineering.
O. Guven.
Water Resources Research, Vol. 19, No. 2, p 441-453, April, 1983. 13 Fig, 3 Tab, 33 Ref.

Descriptors: *Drought, *Streamflow, Probability distribution, Statistical models, Drought severity, Drought duration, Markov process.

On the basis of an available theory approximately valid for stationary first-order two-state Markovian processes and an assumption that the distribution of drought severity is approximately two-parameter gamma, a semiempirical method is proposed for the estimation of the probabilities of extreme drought durations and severities which may occur in the annual flow sequence of a stream during a period of finite length. The method is applied to the annual flows of eight streams in various parts of the world, and the semiempirical probability distributions obtained using this method are compared with experimental distributions obtained using synthetic streamflows generated with a lag one Markov model as well as a long-memory broken line model. The comparisons suggest that considerable insight into the extreme drought probabilities can be gained by the use of the simple semiempirical method introduced here. (Author's abstract)
W84-01344

AN INVESTIGATION OF THE CELLULAR STRUCTURE OF STORMS USING CORRELATION TECHNIQUES,
Lancaster Univ., Bailrigg (England). Dept. of Environmental Sciences.
S. R. Shaw.
Journal of Hydrology, Vol. 62, No. 1-4, p 63-79, April, 1983. 7 Fig, 4 Tab, 19 Ref.

Descriptors: *Statistical methods, *Rainfall distribution, Rainstorms, Storms, Wind, Statistical analysis, Storm cells.

A statistical technique called 'full correlation analysis' has been applied to short-time interval rain data for 8 intense storms recorded at 2 raingauge networks set up by the British Meteorological Office. The technique has been used to investigate the cellular structure of the storms. Certain important storm parameters were estimated including the velocity and direction of movement of the surface rainfall pattern, its mean spatial scale and its lifetime. The results of the analysis suggested a typical cell size of the order of 3 x 1.5 km. The velocities and directions of movement of the surface rainfall patterns agreed well with the 700-mbar wind velocities recorded at the time of the storm. The average lifetime of the storm cells varied from 4 to 6 min. at one network to considerably longer periods at the second network. It appears that the technique of full correlation analysis is particularly suited for application to rain data of the type provided by long storms for which the corresponding meteorological observations were consistent with the existence of cumuliform convective cells embedded in the large-scale cloud mass and for which the centers of these storm cells pass over the recording network. (Moore-IVI)
W84-01367

2C. Snow, Ice, and Frost

ERUPTION-TRIGGERED AVALANCHE, FLOOD, AND LAHAR AT MOUNT ST. HELENS - EFFECTS OF WINTER SNOWPACK,
Cascades Volcano Observatory, Vancouver, WA.
R. B. Waitt, Jr., T. C. Pierson, N. S. MacLeod, R. J. Janda, and B. Voight.
Science, Vol. 221, No. 4618, p 1394-1397, 30 September, 1983. 3 Fig, 12 Ref.

Descriptors: *Flood damage, *Volcanoes, *Snowmelt, Snowpack, *Avalanches, Mass wasting, Mount St. Helens, Washington.

Hot eruption products from Mount St. Helens on 19 March 1982 interacted with a thick snowpack, extending the impact of the eruption beyond the vent. A blast of hot pumice, dome rocks, and gas dislodged crater wall snow that then avalanched through the crater and down the north flank. Except in the crater, the only evidence that the avalanched snow melted during or just after emplacement was a freezing together of the corn-snow granules of the deposit. Apparently heat of internal friction and the warmth of the pumice blocks caused incipient melting during the avalanche. A transient, crescent-shaped lake developed between the dome and the crater wall as a result of the melting of snow on the crater wall and floor, and probably of snow that the avalanche had piled behind the dome. The lake has outlets both east and west of the dome, but the snow apparently melted faster than the water could escape from these two outlets. Abundant floating and entrainment of pumice and ash, and perhaps slushy snow, probably also decreased the fluidity of the water-pumice mixture so that hydraulic ponding was more effective than it would have been had the fluid been only water. A flood of water and pumice discharged simultaneously through both outlets. The maximum flow from the western outlet is delineated by a levee of open-work pumice that emanates from the highest pumice strandline and decends northward to the rampart. Erosion and deposition by this flow destroyed much of the surface morphology of the 1980 pyroclastic flow deposits. As long as Mt. St. Helens remains active, a potential exists for large snow avalanches, floods and lahars to be destructive far from the vent. (Baker-IVI)
W84-01082

AN EARLY GLACIAL TWO-STEP,
R. A. Kerr.
Science, Vol. 221, No. 4606, p 143-144, July, 1983. 1 Fig, 3 Ref.

Descriptors: *Glaciers, *Glaciohydrology, Melting, Ice cover, Glacial sediments, Glacier balance.

Evidence from both the North Atlantic Ocean and the European continent support the proposed theory that deglaciation occurred in two-stages. From sediment samples it is suggested that temperatures rose at least 6 degrees after 13,0000 yr ago but fell to near glacial levels again during the period 11,000 to 10,000 yr ago before warming for good. Apparently cold polar waters retreated to the north and east only to push south again almost as far as they ever did under glacial conditions. The mid-transition cooling seems to be real, at least around the North Atlantic where the major ice sheets were clustered, but there is no agreement about why the transition did not go more smoothly. An additional thought, that the disintegration of the ice sheets could have accelerated ahead of that expected from increasing insolation, is still controversial. Isotopic evidence does indicate that at least one-third of the ice had melted by 13,000 yr ago. It is suggested that ice sheet disintegration can accelerate beyond that expected from direct heating because the initial meltwater would tend to cut off the supply of moisture that feeds snow to the ice sheets. This negative feedback would operate through several effects of the cold, freshwater lid on the North Atlantic. Because the Atlantic was colder, less water would evaporate from the ocean and end up as snow on the ice sheets. Because it was fresher, more of it would freeze in winter, cutting off much moisture in the crucial winter months. The thin, stable surface layer would store less summer heat that could be used to evaporate water in the winter. While this theory fits together well, there is still disagreement based on the timing of the first step of deglaciation: 13,000 to 11,000 vs 16,000 to 13,000 yr ago. (Baker-IVI)
W84-01088

SUSPENDED SEDIMENT PROFILE FOR ICE-COVERED FLOWS,
Department of the Environment, Burlington (Ontario). Hydrology Div.
For primary bibliographic entry see Field 2J.
W84-01135

SNOW COVER AND TEMPERATURE RELATIONSHIPS IN NORTH AMERICA AND EURASIA,
National Aeronautics and Space Administration, Greenbelt, MD. Goddard Space Flight Center.
J. Foster, M. Owe, and A. Rango.
Journal of Climate and Applied Meteorology, Vol. 22, No. 3, p 460-469, March, 1983. 7 Fig, 3 Tab, 24 Ref.

Descriptors: *Snow cover, *Air temperature, Climates, Seasonal variation, North America, Eurasia.

In this study the snow cover extent during the autumn months in both North America and Eurasia has been related to the ensuing winter temperature as measured at several locations near the center of each continent. The relationship between autumn snow cover and the ensuing winter temperatures was found to be much better for Eurasia than for North America. For Eurasia the average snow cover extent during the autumn explained as much as 52% of the variance in the winter (December-February) temperatures compared to only 12% for North America. However, when the average winter snow cover was correlated with the average winter temperature it was found that the relationship was better for North America than for Eurasia. As much as 46% of the variance in the winter temperature was explained by the winter snow cover in North America compared to only 12% in Eurasia. (Author's abstract)
W84-01170

MECHANISM OF RUNOFF GENERATION FROM AN ALPINE GLACIER DURING A STORM TRACED BY OXYGEN O18/O16,
Vrije Univ., Amsterdam (Netherlands). Inst. of Earth Sciences.
For primary bibliographic entry see Field 2E.
W84-01221

COMPUTER MODELLING OF SNOWMELT FLOOD RUNOFF IN NORTH-EAST ENGLAND,
For primary bibliographic entry see Field 2E.
W84-01251

A NUMERICAL STUDY ON CYCLIC BEHAVIOUR OF POLAR ICE SHEETS,
Utrecht Rijksuniversiteit (Netherlands). Inst. voor Meteorologie en Oceanografie.
J. Oerlemans.
Tellus, Vol. 35A, No. 2, p 81-87, March, 1983. 8 Fig, 20 Ref.

Descriptors: *Ice sheets, *Mathematical models, Polar regions, Ice flow, Ice accumulation, Temperature, Glacier surges, Bedrock, Melting, Heat balance, Relaxation oscillations.

Possible cyclic behavior of polar ice sheets is studied with a numerical ice-flow model. The model includes a calculation of bedrock adjustment and temperature field in the ice sheet. Basal water is traced and affects ice-mass discharge. Relaxation oscillations occur only for low ice-accumulation rates (less than 5 cm ice depth per year). For larger ice-accumulation rates, 2 steady-state regimes exist, depending on temperature: an ice sheet frozen to the bottom, and an ice sheet subject to basal melting everywhere. The volume of the latter is considerably smaller (about 65% of that of the 'cold sheet'). In general, the mean basal ice temperature decreases with increasing ice accumulation rate. This is due to the advection term in the heat equation (which has been ignored in earlier studies of ice-sheet surging). (Author's abstract)
W84-01310

ONE-DIMENSIONAL STOCHASTIC MODEL OF ICE MOTION IN WESTERN NORTON SOUND, ALASKA, U.S.A.,
Alaska Univ., Fairbanks. Geophysical Inst.
W. J. Stringer.
Arctic and Alpine Research, Vol. 15, No. 2, p 213-221, May, 1983. 5 Fig, 1 Tab, 10 Ref.

Descriptors: *Floating ice, *Ice drift, *Statistical models, Model studies, Sounds, Pack ice, Oil spills, Fate of pollutants, Ice budget, Alaska.

Analysis of short-term ice-floe displacement fields in western Norton Sound, Alaska, yields a statistical model for long-term ice-floe drift. The short-term ice motions are found to be normally distributed with an average velocity of 3.6 km/d westward, i.e., toward the entrance of the sound, and with a standard deviation of around 6 km/d. These short-term data are used to develop a one-dimensional stochastic model to describe long-term ice drifts along the axis of the sound. The statistically projected, long-term drifts are compared with observed long-term drifts and found compatible. These results indicate that although pack ice within Norton Sound is generally moving toward its entrance, a high degree of variability also exists such that even after a period as long as twenty days, a 70% probability remains of a net motion into the sound. These data are used to estimate the annual ice budget for Norton Sound and the fractional contribution of Norton Sound ice to the Bering Sea ice budget. In addition, the results are used to characterize the possible fate of a petroleum spill associated with pack ice in Western Norton Sound. (Author's abstract)
W84-01381

2D. Evaporation and Transpiration

A SOIL AND ATMOSPHERIC BOUNDARY LAYER MODEL FOR EVAPOTRANSPIRATION AND SOIL MOISTURE STUDIES,
Computer Sciences Corp., Silver Spring, MD.
For primary bibliographic entry see Field 2G.
W84-01339

2E. Streamflow and Runoff

ESTIMATING UNIT HYDROGRAPH PEAK RATE FACTORS,
Maryland Univ., College Park. Dept. of Civil Engineering.
R. H. McCuen, and T. R. Bondelid.
Journal of Irrigation and Drainage Engineering, Vol. 109, No. 2, p 238-250, June, 1983. 3 Fig, 2 Tab, 11 Ref.

Descriptors: *Hydrologic models, *Peak rate factor, Watersheds, Hydrographs, Runoff volume, Drainage area, Coastal areas, Mathematical models.

The Soil Conservation Service (SCS) dimensionless unit hydrograph model TR-20 is widely used for hydrologic design. The model uses a dimensionless unit hydrograph, with the drainage area, the depth of the runoff volume, the time-to-peak, and the SCS peak rate factor required to dimensionalize the unit hydrograph. A standard value of 484 for the peak rate factor is commonly used. While vague guidelines have been provided for modifying the value of the parameter, almost all designs are made using a value of 484. A method is presented that provides a systematic means of obtaining a value of the peak rate factor that is unique to a watershed. The method only requires a runoff curve number map, which should be developed to use the TR-20 model anyway. Application of the method to six watersheds, including three coastal basins, indicated that the method increases the accuracy of prediction; the peak rate factors computed using the procedure outlined compared very favorably with the values obtained by optimizing on measured rainfall hyetographs and runoff hydrographs. The results indicate that the value of 484 is too large for coastal watersheds on the Delmarva peninsula. (Author's abstract)
W84-01150

ON THE MATHEMATICS OF STORAGE ROUTING,
Vanderbilt Univ., Nashville, TN. Dept. of Civil and Environmental Engineering.
C.-N. Chang, E. Da Motta Singer, and A. D. Koussis.
Journal of Hydrology, Vol. 61, No. 4, p 357-370, March, 1983. 3 Tab, 14 Ref.

Descriptors: *Routing, *Storage, Mathematical models, Simulation, Flood routing, Muskingum scheme, Hydrologic models, Storage routing.

Some mathematical aspects of storage routing are investigated analytically and through numerical simulation. The minimum size of the time interval required to eliminate computed values at the beginning of the outflow hydrograph falling below the initial steady flow rate is given for two routing schemes. The stability behavior of a refined Muskingum scheme is explored; it is found that values of the weighting coefficient up to 1.0 may be used with appropriately specified time intervals. The concept of 'relative' storage is analyzed and it is shown that it is unnecessary when the correct initial condition of the storage is considered. The classical best straight-line fit procedure between storage and weighted discharge is investigated. In an example case, it is demonstrated that this method of system identification is not reliable. The possibility of using discharge-dependent parameters is discussed. (Author's abstract)
W84-01217

MECHANISM OF RUNOFF GENERATION FROM AN ALPINE GLACIER DURING A STORM TRACED BY OXYGEN O18/O16,
Vrije Univ., Amsterdam (Netherlands). Inst. of Earth Sciences.
A. A. Van de Griend, and J. A. Arwert.
Journal of Hydrology, Vol. 62, No. 1-4, p 263-278, April, 1983. 5 Fig, 2 Tab, 14 Ref.

Descriptors: *Glaciers, *Storm runoff, Snowmelt, Rainfall-runoff relationships, Oxygen isotopes, Snow accumulation, Glaciohydrology, Glacial runoff, Isotope studies.

As a result of progressive fractionation and seasonal effects in snow accumulation on a glacier, O18/O16 ratios of glacier meltwater differ significantly from those of summer precipitation. O18/O16 ratios of precipitation and runoff have been used to separate pluvial and glacial runoff components from an alpine glacier during one single storm. It was found, especially during the rising limb of the hydrograph, that the bulk of runoff consisted of pre-storm meltwater, stored in the glacier body. On the basis of the results a better insight could be gained into the storage push-through process in the glacier body, active during the storm. This leads to a distinction between recharge and discharge zones on the glacier, the discharge zone being the main source area for quick response on rainfall. Thus, the mechanism of runoff generation of the alpine glacier studied is comparable with that found in normal headwater catchments. (Author's abstract)
W84-01221

CHEMICAL COMPOSITION OF RAINWATER AND FLOODWATERS IN THE NEGEV DESERT, ISRAEL,
Ben-Gurion Univ. of the Negev, Sde Boker (Israel). Jacob Blaustein Inst. for Desert Research.
R. Nativ, A. Issar, and J. Rutledge.
Journal of Hydrology, Vol. 62, No. 1-4, p 201-223, April, 1983. 9 Fig, 6 Tab, 23 Ref.

Descriptors: *Floodwater, *Rainwater, *Water chemistry, *Salts, Deserts, Calcium, Magnesium, Sodium, Potassium, Carbonates, Chloride, Sulfates, Ions, Catchment areas, Lithology, Israel.

Rain and floodwater were sampled by self-sealing samplers scattered over the area of two drainage basins in the Negev Desert of Israel. The sampling was carried out during the winters of 1978-1981. Water was analyzed for the following ions: Ca(2+), Mg(2+), Na(+), K(+), HCO3(-), Cl(-) and SO4(2-). The chemical type of the rain and floodwater as well as the total quantities of salts

precipitated and drained out from the basins were investigated. The chemical characteristics of the rainwater falling in the Negev resemble those of rainwater in northern Israel, but the absolute quantities of ions are smaller. The total quantities of salts introduced into the basin were found to be larger than the quantities of salts drained out by the floods. The chemical composition of the floodwater was found to be governed by the lithology of the drainage basin and not by the initial chemical characteristics of the rain from which it was derived. (Author's abstract)
W84-01224

UNIT-STEP FUNCTION RESPONSE FOR SEVERAL HYDROLOGICAL CONCEPTUAL MODELS,
Academia Sinica, Beijing (China). Inst. of Geography.
G.-T. Wang, and K. Wu.
Journal of Hydrology, Vol. 62, No. 1-4, p 119-128, April, 1983. 4 Ref.

Descriptors: *Rainfall runoff relationships, *Mathematical models, Unit hydrographs, Laplace transform, Model studies.

To solve a rainfall runoff problem through the use of a conceptual model usually involves determining the instantaneous unit hydrograph (IUH) from rainfall and runoff records. In use it is necessary to convert the IUH into a unit hydrograph of finite duration D, DUH. For this the S-curve may be used. In this paper the rainfall data in 'blocks' of finite duration is represented by using the unit-step function. The output is obtained as the inverse Laplace transform of the product of the Laplace transform of the input so defined and the transfer function of the system. In this way output can be obtained corresponding to different conceptual models of the unit hydrograph. (Author's abstract)
W84-01227

ANNUAL FLOODS IN SOUTHWESTERN BRITISH COLUMBIA, CANADA,
McMaster Univ., Hamilton (Ontario). Dept. of Geography.
P. Waylen, and M.-K. Woo.
Journal of Hydrology, Vol. 62, No. 1-4, p 95-105, April, 1983. 4 Fig, 1 Tab, 7 Ref.

Descriptors: *Annual floods, *Gumbel distribution, *Snowmelt, *Rainfall, British Columbia, Seasonal distribution, Hydrology, Mathematical models.

In southwestern British Columbia there exists a transition from rain-generated floods in the west to snowmelt floods in the east. When a single process dominates, the Gumbel distribution provides an adequate fit to observed flood exceedance probabilities. The two processes produce distinct timing and magnitude characterizations in the resultant floods. The area of transition between these two sets of conditions displays varying mixtures of both characteristics which can best be fitted by a compounded Gumbel distribution. It is proposed that this technique is generally applicable wherever annual flood series are generated by more than one hydrological process. (Author's abstract)
W84-01229

COMPUTER MODELLING OF SNOWMELT FLOOD RUNOFF IN NORTH-EAST ENGLAND,
D. R. Archer.
Proceedings of the Institution of Civil Engineers, Vol. 75, p 155-173, June, 1983. 5 Fig, 3 Tab, 29 Ref.

Descriptors: *Snowmelt, *Flood forecasting, *Runoff rates, Computer models, Simulation, Flood hydrographs, England.

Components of snow models, as related to British conditions, are discussed. A computer simulation model is described in which the snowmelt phase is linked with alternative systems of lumped or distributed catchment routing. The catchment phase of the model is calibrated using winter rainfall events on three upland catchments in north-east England. Then, with fixed catchment routing parameters for a particular catchment, snow phase parameters are optimized. Observed snowmelt runoff hydrographs are satisfactorily reproduced by model simulation, in most events. Results confirm that point melt and yield rates often exceed the current design rate for winter probable maximum flood estimation. The model provides a basis for operational snowmelt flood forecasting. (Author's abstract)
W84-01251

FLOOD FREQUENCY ANALYSIS FOR SMALL WATERSHEDS IN SOUTHERN ILLINOIS,
Southern Illinois Univ. at Carbondale. Dept. of Forestry.
S.-K. Chong, and S. M. Moore.
Water Resources Bulletin, Vol. 19, No. 2, p 277-282, April, 1983. 8 Fig, 2 Tab, 12 Ref.

Descriptors: *Flood frequency, *Gaging stations, *Small watersheds, *Illinois, Flood peak, Hydrologic data, Regression analysis.

Twenty-two gaging stations were selected for developing a regional flood frequency curve for small (area less than 2 square miles) watersheds in southern Illinois. Five probability functions were compared, and the extreme value type I function was selected to develop the regional flood curve. The curve was generated with the index flood method and also another empirical method that related the function parameters to the watershed area. Estimated peak discharges with various return periods were compared with the results obtained from multiple regression analysis. (Author's abstract)
W84-01276

SIMULATING SOIL WATER RECESSION COEFFICIENTS FOR AGRICULTURAL WATERSHEDS,
National Aeronautics and Space Administration, Greenbelt, MD. Goddard Space Flight Center.
B. J. Choudhury, and B. J. Blanchard.
Water Resources Bulletin, Vol. 19, No. 2, p 241-247, April, 1983. 5 Fig, 1 Tab, 34 Ref.

Descriptors: *Agricultural watersheds, *Antecedent precipitation index, *Soil water, Agricultural runoff, Evapotranspiration, Remote sensing, Satellite technology, Mathematical models, Simulation, Recession.

The antecedent precipitation index (API) has been a useful indicator of soil moisture conditions for watershed runoff calculations, and recent attempts to correlate this index with spaceborne microwave observations have been fairly successful. The prognostic equation for soil moisture used in some of the atmospheric general circulation models (GCM) together with Thornthwaite-Mather parameterization of actual evapotranspiration leads to API equations. The recession coefficient for API is found to depend on climatic factors as contained in potential evapotranspiration and to depend on soil texture as reflected by field capacity and permanent wilting point. A recently developed model for global insolation is used with climatological data for Wisconsin to simulate the annual trend of the recession coefficient. Good quantitative agreement is shown with the observed trends at Fennimore and Colby watersheds in Wisconsin. This study suggests that API could be a unifying concept for watershed and atmospheric general circulation modeling. (Author's abstract)
W84-01280

STREAM FLOW IN RELATION TO OHIA FOREST DECLINE ON THE ISLAND OF HAWAII,
Forest Service, San Francisco, CA. Pacific Southwest Region.
R. D. Doty.
Water Resources Bulletin, Vol. 19, No. 2, p 217-221, April, 1983. 2 Fig, 4 Tab, 8 Ref.

Descriptors: *Stream discharge, *Soil-water-plant relationships, *Hawaii, *Forest hydrology, Forest watersheds, Precipitation, Rainfall-runoff relationships, Water quality, Ohia.

Dieback of the ohia forest over a large part of the Hilo watershed and adjacent areas has resulted in a severe loss of the overstory crown component of the vegetation. The decline could cause serious damage to the watershed. To evaluate possible changes in conditions in the Hilo area since the decline began, stream flow, water quality, and precipitation data from 1929 to 1980 were collected and analyzed. The limited data available do not indicate that the ohia decline has resulted in a significant change in either annual stream flow or peak stream flow of a stream discharging from the ohia forest in the Hilo area. Suspended sediment production of two streams remains well within accepted levels as does the chemical makeup of components dissolved in the streams. (Author's abstract)
W84-01284

SALT TRANSPORT BY THE SOUTH PLATTE RIVER IN NORTHEAST COLORADO,
Impolusa, Bilbao (Spain).
R. Gomez-Ferrer, D. W. Hendricks, and C. D. Turner.
Water Resources Bulletin, Vol. 19, No. 2, p 183-190, April, 1983. 8 Fig, 2 Tab, 12 Ref.

Descriptors: *Salinity, *South Platte River, *Colorado, *Stream discharge, Dissolved solids, Irrigation effects, Supplemental irrigation, Drainage, Leaching.

The salinity of the lower South Platte River in Colorado is characterized by plotting the average annual flow, total dissolved solids, and salt mass flow against distance along the stream. The plots show that salts are being leached from the irrigated lands above Greeley and are being deposited on the irrigated lands below Greeley. The salt deposition on the lower lands will result in their salination. The plots show also that fall and winter stream flows carry most of the salt loads. These fall and winter flows are stored in off stream reservoirs for use during the irrigation season. Therefore these salts are transferred to the lower irrigated lands where they accumulate. The salt balance for these lands can be improved by permitting the fall and winter flows to leave the basin, or by providing adequate land drainage coupled with supplemental irrigation water. (Author's abstract)
W84-01289

TECHNIQUE TO RECONSTRUCT RIVER DISCHARGE HISTORY FROM TREE-RINGS,
Illinois State Water Survey, Champaign. Climatology and Meteorology Section.
W. M. Wendland, and D. Watson-Stegner.
Water Resources Bulletin, Vol. 19, No. 2, p 175-181, April, 1983. 2 Fig, 4 Tab, 16 Ref.

Descriptors: *Dendrochronology, *Stream discharge, *Flood plains, Dating, Paleoclimatology, Flood frequency, Precipitation, Mathematical model.

Cores were obtained from several tree species located both on a river floodplain and a nearby terrace. A ratio of annual tree growth of floodplains to terrace growth was developed and shown to be related to the annual river discharge. Growth ratios from the time prior to written records can therefore be used to reconstruct river discharge and infer past unrecorded flood frequency. Oak and basswood ratios yielded the best models for discharge reconstruction, whereas those of elm and birch were less useful. This method permits reconstruction of river discharge from an assemblage of growth cores obtained within a relatively small area. (Author's abstract)
W84-01290

APPROXIMATE SAMPLING DISTRIBUTION OF THE SERIAL CORRELATION COEFFICIENT FOR SMALL SAMPLES,
Geological Survey, Reston, VA.
G. D. Tasker.
Water Resources Research, Vol. 19, No. 2, p 579-582, April, 1983. 2 Fig, 1 Tab, 9 Ref.

Descriptors: *Correlation coefficient, *Streamflow, *Model studies, *Sampling, Mathematical studies, Correlation analysis, Distribution.

The sampling distribution of the lag one serial correlation coefficient is of some interest to hydrologists. It may be used as a likelihood function in an application of Bayes rules to obtain the posterior distribution of the population serial correlation coefficient given a sample estimate. In an earlier, very large Monte Carlo study, a rather complicated density function for an estimator of serial correlation was derived. This report provides a much less complicated approximate distribution of the sample serial correlation coefficient for various numbers of observations and shows it to be a very good approximation in the range of interest to hydrologists. (Baker-IVI)
W84-01332

LAND USE, FLOODS, AND CHANNEL CHANGES: UPPER MIDDLE FORK WILLAMETTE RIVER, OREGON (1936-1980),
Oregon State Univ., Corvallis. School of Forestry.
For primary bibliographic entry see Field 4C.
W84-01346

BAR RESISTANCE IN GRAVEL BED STREAMS AT BANKFULL STAGE,
California Univ., Berkeley. Dept. of Geology and Geophysics.
K. L. Prestegaard.
Water Resources Research, Vol. 19, No. 2, p 472-476, April, 1983. 5 Fig, 1 Tab, 16 Ref.

Descriptors: *Flow resistance, *Stream beds, *Gravel, Channel morphology, Grain roughness, Sinuosity, Keulegan equation.

Total flow resistance in gravel bed streams with high width/depth ratios and low sinuosities is primarily a result of grain and bar roughness. The relative importance of these two roughness elements has not been established. The relative importance of grain and bar resistance is examined for 12 straight and divided gravel bed reaches at bankfull stage by using the Keulegan equation to determine a resistance division of energy slope. The remaining slope is assumed to represent the relative importance of bar resistance. Bar resistance accounts for 50 to 75% of the total resistance in these reaches. Calculated values of reach-averaged bar slope correlate closely with field measurements of bar magnitude. (Author's abstract)
W84-01347

SOME REMARKS ON THE TRUNCATION USED IN PARTIAL FLOOD SERIES MODELS,
Ecole Polytechnique, Montreal (Quebec).
F. Ashkar, and J. Rousselle.
Water Resources Research, Vol. 19, No. 2, p 477-480, April, 1983. 12 Ref.

Descriptors: *Flood flow, *Mathematical models, Statistical analysis, Stream discharge, Flood peak, Flood magnitude, Flood frequency.

In the partial duration series approach to the problem of flood analysis, the truncation level above which streamflow is regarded as flood flow plays a key role. In the absence of a systematic and well defined method for selecting such a level in practice, it is desirable to know how different choices affect the obtained results. A mathematical investigation based on some commonly used partial flood series models shows that once the time-dependent Poisson process, used in modeling flood frequency is found applicable with a certain truncation level, then it should remain so with any higher truncation level. This same property holds true for the exponential distribution widely used in the study of flood magnitude. Guidelines such as those put forward by the Water Resources Council in relation to partial flood series models should be followed with caution and the effect of any restrictions put on such models by their underlying assumptions and mathematical characteristics should always be examined. If the Poisson and exponential distributions are to be used then the choice of the base level should be made primarily on mathematical grounds rather than on economic or engineering considerations. (Moore-IVI)
W84-01348

ESTIMATING A REGIONAL FLOOD FREQUENCY DISTRIBUTION,
Cornell Univ., Ithaca, NY. Dept. of Environmental Engineering.
J. R. Stedinger.
Water Resources Research, Vol. 19, No. 2, p 503-510, April, 1983. 5 Fig, 2 Tab, 34 Ref.

Descriptors: *Flood frequency, *Flood flow, Peak flow, Mathematical models, Statistical analysis.

When floods at different sites are assumed to arise from the same distribution except for scale (U.S. Geological Survey's Index Flood Method), one can attempt to identify the dimensionless flood-flow frequency distribution by normalizing small samples by each sample's sample mean. Unfortunately, the resultant curve may be a poor description of the true dimensionless flood distribution. This problem can be overcome by working with the logarithms of the peak flow values and using unbiased moment or probability weighted moment estimators. However, the correlation among concurrent flood flows in a region is shown to place severe limits on the accuracy with which a distribution's moments can be estimated with many such correlated records. (Author's abstract)
W84-01352

DESIGN EVENTS WITH SPECIFIED FLOOD RISK,
Cornell Univ., Ithaca, NY. Dept. of Environmental Engineering.
J. R. Stedinger.
Water Resources Research, Vol. 19, No. 2, p 511-522, April, 1983. 4 Fig, 3 Tab, 76 Ref. CME8010889.

Descriptors: *Flood flow, Design floods, Statistical analysis, Probability, Flood plain management, Flood damage.

A maximum likelihood or method of moments estimate of the 99 percentile of a flood flow distribution is the traditional choice for the 100-year design flood event in flood plain planning. Because such estimates ignore the small-sample properties of quantile estimators, the resulting design event values will be exceeded with a probability in excess of that intended. For a sample size of 16 the estimated 100-year flood is, in expectation, the 50-year flood. Bayesian and classical statistical approaches can be used to develop design flood values which, given available hydrologic information, will (on average) be exceeded with the specific 1% design probability. Bias in estimates of expected flood damages and procedures for using regional information at gauged and ungauged sites are discussed. (Author's abstract)
W84-01353

2F. Groundwater

ANALYTICAL SOLUTION FOR TRANSIENT TWO-DIMENSIONAL UNCONFINED GROUNDWATER FLOW,
Auckland Univ. (New Zealand). Dept. of Civil Engineering.
V. U. Nguyen, and A. J. Raudkivi.
Hydrological Sciences, Vol. 28, No. 2, p 209-219, June, 1983. 3 Fig, 1 Tab, 12 Ref.

Descriptors: *Differential equations, *Groundwater movement, Water table fluctuations, Laplace equation, Seepage, Flow rates, Mathematical studies.

An analytical solution of the differential equations describing the transient unconfined groundwater flow into a large cut such as an open strip mine is described. The free surface boundary of flow is time dependent and is not known beforehand. Discharge comes from the elastic storage and also from the lowering of the water table. The solution is based on a Laplace type formulation and provides, with the aid of the enclosed numerically evaluated functions, a quick and easy method of estimation of the phreatic surface and the flow rate as a function of time. Under certain conditions the solution approximates that based on the Dupuit approximation which neglects the vertical mass transport and puts the horizontal velocity proportional to the slope of the free surface. (Baker-IVI)
W84-01112

HP41C AND T159 PROGRAMS FOR ANISOTROPIC CONFINED AQUIFERS,
Kansas Univ., Lawrence.
A. D. Parr, J. G. Melville, and F. J. Molz.
Ground Water, Vol. 21, No. 2, p 212-220, March-April, 1983. 7 Fig, 4 Tab, 7 Ref.

Descriptors: *Permeability coefficient, *Confined aquifers, *Drawdown, *Computer programs, Pumping tests, Anisotropy, Mathematical studies.

Programs are presented for the HP41C and T159 programmable calculators for determining the ratio of horizontal to vertical hydraulic conductivity in anisotropic confined aquifers from pumping test data or for calculating drawdown given the aquifer parameters. The programs, based on Hantush's drawdown equations, eliminate the need to perform triple interpolation in obtaining the drawdown correction factor. By specifying a range of conductivity ratios, they can be used to solve the inverse problem given the drawdown data for a single observation well and the transmissivity and storage coefficient of the aquifer. The programs are illustrated by examples using the drawdown data from a pumping test performed in an anisotropic confined aquifer near Mobile, Alabama. (Moore-IVI)
W84-01115

GROUND-WATER MODELING WITH AN INTERACTIVE COMPUTER,
Idaho Univ., Moscow. Dept. of Agricultural Engineering.
G. L. Bloomsburg, and R. E. Rinker.
Ground Water, Vol. 21, No. 2, p 208-211, March-April, 1983. 3 Fig, 2 Ref. J0100013.

Descriptors: *Computer models, *Groundwater movement, *Mine drainage, Computer programs, Simulation, Saturated flow, Mine hydrology.

A large finite element program has been adapted to a PDP-11/23 minicomputer to obtain the advantages of an interactive computer system. The program used is UNSAT2, a code for unsteady, saturated and/or unsaturated flow of ground water. Some of the advantages of this interactive system are: ease of data input by the use of a digitizer; the opportunity to review all output files and to select for printing only those of interest; and the opportunity to change the physical boundaries of a problem at any desired time to make use of new information as a project progresses. This feature is particularly useful in mine-related water inflow predictions. This characteristic facilitates the simulation of flow into a vertical mine shaft as the shaft is being developed. To demonstrate the versatility of the program, it was used to simulate flow into a vertical mine shaft being developed in the Piceance Basin of Colorado. The major disadvantage is increased computational time. However, this disadvantage may not be particularly great because many organizations are not required to cost-account time on a minicomputer whereas this may not be the case for large machines. (Moore-IVI)
W84-01116

NOORDBERGUM EFFECT AND CHARACTERIZATION OF AQUITARDS AT THE RIO MAIOR MINING PROJECT,
Laboratorio Nacional de Engenharia Civil, Lisbon (Portugal).
J. D. Rodrigues.
Ground Water, Vol. 21, No. 2, p 200-207, March-April, 1983. 8 Fig, 1 Tab, 11 Ref.

Descriptors: *Aquitards, *Sand aquifers, *Permeability coefficient, Pumping tests, Water level, Noordbergum effect, Drawdown, Portugal, Rio Maior Basin.

The planned exploitation of the Rio Maior lignite deposits will require a major dewatering program involving a thick leaky sand aquifer, and a heterogeneous and anisotropic aquitard complex. Diatomite, lignite, and clay are the main lithologies found in this aquitard complex. Characterization of the sand aquifer was accomplished by performing pumping tests with interpretations for steady-state and nonsteady-state conditions. Aquitards were characterized by using both laboratory and field tests to determine hydraulic conductivity. Field methods were either those commonly adapted to leaky aquifers using water-level data taken from observation wells tapping the underlying sand aquifer or those using water-level data taken from piezometers located at the same distance from the pumping well and screened in the aquitard and in the aquifer. Field values of hydraulic conductivity are greater than laboratory values. In several piezometers the Noordbergum effect was observed during pumping tests. Redistribution of the loads originated by the pumping in the underlying sand aquifer is considered to be responsible for the reverse water-level response in the overlying lignite-diatomite complex. The Noordbergum effect has some influence in the application of the ratio method. On a practical basis, it seems reasonable to use the Noordbergum effect to compute drawdowns in the aquitards, and this leads to somewhat higher values for vertical hydraulic conductivities. (Author's abstract)
W84-01117

HYDROGEOLOGY OF PIPELINE CANYON, NEAR GALLUP, NEW MEXICO,
New Mexico Health and Environment Dept., Santa Fe. Environmental Improvement Div.
R. R. Raymondi, and R. C. Conrad.
Ground Water, Vol. 21, No. 2, p 188-198, March-April, 1983. 7 Fig, 5 Tab, 12 Ref.

Descriptors: *Geohydrology, *Alluvium, Infiltration, Mine drainage, Groundwater recharge, Groundwater movement, Groundwater pollution, Water quality, Sodium, Sulfates, Geologic fractures, New Mexico, Pipeline Canyon.

The principal water-bearing units (in descending stratigraphic order) in Pipeline Canyon are the alluvium, the Dilco Coal Member of the Crevasse Canyon Formation, the Torrivio Sandstone Member of the Gallup Formation, and the Upper and Lower Gallup Sandstones. Presently, the alluvium is recharged by a perennial, southward-flowing stream sustained by mine dewatering discharge in addition to natural precipitation and runoff. Localized infiltration has created ground-water mounds in the alluvium. Artesian conditions may exist in sandstone units which are adjacent and hydraulically connected to the alluvium in these areas. Basement faults have produced the Fort Wingate and Pipeline Canyon lineaments which intersect in the area of investigation. Fault-related fracturing of the sandstones allows for significant ground-water recharge via the overlying alluvium. Flow in the sedimentary formations is generally to the northeast, while the alluvial system flows to the southwest. The natural water quality for the aquifers in the area is dominated by sodium and sulfate ions. However, complete characterization of the natural water quality is complex because of ground-water contamination by acidic tailings fluids from a local uranium mill. (Author's abstract)
W84-01118

DETERMINING HYDRAULIC CONDUCTIVITY DISTRIBUTIONS IN A MOUNTAINOUS AREA USING MATHEMATICAL MODELING,
Campbell Geoscience Ltd., Calgary (Alberta).
G. R. Jamieson, and R. A. Freeze.
Ground Water, Vol. 21, No. 2, p 168-177, March-April, 1983. 10 Fig, 2 Tab, 4 Ref.

Descriptors: *Permeability coefficient, *Mathematical models, *Groundwater movement, Water table, Groundwater recharge, Geohydrology, Geothermal resources, Volcanoes, Hydrologic budget, Meager Mountain, Vancouver, British Columbia.

Meager Mountain is a recently-active andesite-dacite volcano situated 160 km NNW of Vancouver, British Columbia. The mountain is presently being jointly evaluated by the Geological Survey of Canada and the British Columbia Hydro and Power Authority as a potential geothermal resource. Limited existing and field-generated geological and hydrogeological data were employed to evaluate the ground-water flow regime at the study area. Mathematical modeling was carried out to determine the feasible range of ground-water-flow characteristics in the area. Field observations indicate that the water table is located at an intermediate elevation in the mountain system with the discharge area confined to the portion of the valley covered by unconsolidated deposits. Water balance calculations for the Lillooet River basin and base-flow determinations in the Meager Creek basin indicated that 14 to 17% of the total precipitation recharges the ground-water system. Various possible geological configurations were mathematically modeled with the water-table configuration and recharge rates restricted to the above ranges. The model results were used to predict the variations in the hydraulic conductivity in each geological formation. The results fell into a discrete range of values thought to be within an order of magnitude of the actual values. (Author's abstract)
W84-01119

GROUNDWATER FLOW AND IMPLICATIONS FOR GROUNDWATER CONTAMINATION NORTH OF PREWITT, NEW MEXICO, U.S.A.,
New Mexico Inst. of Mining and Technology, Socorro. Dept. of Geoscience.
D. B. Stephens.
Journal of Hydrology, Vol. 61, No. 4, p. 391-408, March, 1983. 8 Fig, 2 Tab, 23 Ref.

Descriptors: *Groundwater movement, *Groundwater pollution, *New Mexico, Geohydrology, Permeability coefficient, Groundwater recharge, Topography, Aquitards, Mathematical models, Path of pollutants.

In the southern San Juan Basin, New Mexico, strata of Permian and younger age dip gently toward the center of the basin. Most previous investigators believed that recharge to these strata occurred by precipitation on the outcrops and groundwater flowed downdip to the north and northeast. Recent water-level measurements in an undeveloped part of the basin near Prewitt, New Mexico, show that groundwater at shallow depths in alluvium and bedrock flows southward, opposite to the dip direction, and toward a major ephemeral drainage in a strike valley. North of this area, groundwater in deep bedrock aquifers does appear to flow northward. This information suggests that there are two groundwater circulation patterns; a shallow one controlled by topography and a deeper one controlled by geologic structure. Significant amounts of recharge to sandstone aquifers by infiltration through outcrops is unlikely due to the near-vertical exposures on cliffs, the gentle dip of the strata, and small annual precipitation. Numerical model results suggest that recharge to bedrock aquifers may be from downward leakage via aquitards over large areas and leakage from narrow alluvial aquifers in the subcrop area. The recharge mechanism is controlled by the hydraulic conductivity of the strata. As the flow path is controlled by hydraulic conductivity contrasts, geologic structure, and topography, contamination movement from surface impoundments is likely to be difficult to predict without a thorough hydrogeolical site investigation. (Author's abstract)
W84-01215

ASYMPTOTIC SOLUTIONS TO THE CONVECTION-DISPERSION EQUATION AND POWELL'S OPTIMIZATION METHOD FOR EVALUATING GROUNDWATER VELOCITY AND DISPERSION COEFFICIENTS FROM OBSERVED DATA OF SINGLE DILUTION TESTS,
National Research Inst. of Agricultural Engineering, Yatabe (Japan). Dept. of Water Management.
K. Fujinawa.
Journal of Hydrology, Vol. 62, No. 1-4, p 333-353, April, 1983. 6 Fig, 5 Tab, 20 Ref.

Descriptors: *Groundwater movement, *Convection, *Hydrodynamic dispersion, Mathematical studies, Dispersion, Solute transport, Tracers, Boreholes.

Groundwater velocity and hydrodynamic dispersion coefficients can be determined simultaneously from observed data of solute concentration at the center of a single borehole. Two types of asymptotic analytical solutions to the convection-dispersion equation were proved to be applicabie to analyze single borehole dilution tests. In order to calculate the groundwater velocity, and the longitudinal and transverse dispersion coefficients as three unknown variables in the asymptotic solutions, Powell's optimization method was applied to several cases together with the optimization method of Fletcher and Powell. The results of the application of these two optimization methods to several assumed sets and one actual experimental set of tracer concentrations showed that Powell's method based upon a conjugate direction procedure without calculating derivatives is more reliable, more flexible and much faster in converging to the true values than the method of Fletcher-Powell, which is based on a conjugate gradient procedure utilizing both criterion functions and their first derivatives. Furthermore, when Powell's optimization method was applied together with the proposed asymptotic solution to single borehole dilution data measured in field, the obtained value of the groundwater velocity, and the longitudinal dispersion coefficients were quite reasonable. (Author's abstract)
W84-01218

ORIGIN AND HISTORY OF NITRATE IN CONFINED GROUNDWATER IN THE WESTERN KALAHARI,
National Physical Research Lab., Pretoria (South Africa). Natural Isotopes Div.
T. H. Heaton, A. S. Talma, and J. C. Vogel.
Journal of Hydrology, Vol. 62, No. 1-4, p. 243-262, April, 1983. 8 Fig, 2 Tab, 36 Ref.

Descriptors: *Confined groundwater, *Nitrates, Groundwater recharge, Argon, Isotope studies, Climate, Dissolved gas, Confined aquifers, Nitrogen isotopes, Kalahari, History.

Data are presented for nitrate, dinitrogen and argon concentrations and N15/N14 ratios in groundwater, with radiocarbon ages up to 40,000 yr for three confined sandstone aquifers in the western Kalahari of South West Africa/Namibia. The nitrate is probably generated within the soil of the recharge areas, and its production rate during the period 3000-40,000 B.P. has remained between 0.5 and 1.6 meq NO3(-)1(-1) of recharge water, with delta N15 between +4 and +8 0/00. Variations in the amount of nitrate and of 'excess air' in groundwater recharge are found, and can only reflect changes in the environmental conditions during recharge. They must therefore be caused by the climatic changes that have taken place during the past 25,000 yr. (Author's abstract)
W84-01222

MATHEMATICAL MODEL STUDY OF AN AQUIFER WITH SIGNIFICANT DEWATERING,
Birmingham Univ. (England). Dept. of Civil Engineering.
K. R. Rushton, and D. C. H. Senarath.
Journal of Hydrology, Vol. 62, No. 1-4, p 143-158, April, 1983. 7 Fig, 13 Ref.

Descriptors: *Mathematical models, *Groundwater recession, *Confined aquifers, Groundwater movement, Dewatering, Pumping, Simulation, Groundwater storage, England.

A finite-difference numerical technique is used to study the behavior of a Chalk aquifer in southeast England. Before abstraction commenced in the confined region the flow through the confined was small. Increasing abstraction from the confined region has caused an increase in the groundwater gradient and therefore in the flow from the unconfined region; yet this inflow is only about 75% of the current abstraction rate. The additional water

is provided by localized dewatering around certain of the abstraction sites. A technique is devised for including this local dewatering in a regional model. The numerical model is used to understand the flow mechanisms within the aquifer with special emphasis on the balance between inflows from the unconfined region and water released from storage due to dewatering. The simulation covers a time period of over 100 yr. (Moore-IVI)
W84-01226

A STOCHASTIC SYSTEMS MODEL OF GROUNDWATER LEVEL FLUCTUATIONS,
Ottawa Univ. (Ontario). Dept. of Civil Engineering.
K. Adamowski, and T. Hamory.
Journal of Hydrology, Vol. 62, No. 1-4, p 129-141, April, 1983. 13 Fig, 3 Tab, 13 Ref.

Descriptors: *Mathematical models, *River flow, *Groundwater level, Analysis of variance, Water table fluctuations, Canada.

Time series analysis techniques were used to develop an input-output model of a groundwater level system. Groundwater level observations of the Castor River Watershed were collected at Metcalf, Ontario. A second-order model with five parameters was found adequate. The unit-step response function suggested that a sudden rise in riverflow to unity is followed by a very gradual increase in groundwater level until after about 18 days when the groundwater regime conditions are established. The gain function damps out after an initial rise, indicating that the low frequency components (i.e. years, months) dominate the system. Thus, groundwater levels are more variable during high river flows than during low-flow conditions. The phase function reveals that in general, groundwater level lags behind riverflow by about 0-1.6 months. The fitted model accounts for 95.37% of the variance. (McKeon-IVI)
W84-01233

ANALYTICAL SOLUTIONS FOR RECTANGULAR AQUIFERS WITH THIRD-KIND (CAUCHY) BOUNDARY CONDITIONS,
Delaware Univ., Newark. Dept. of Civil Engineering.
M. Y. Corapcioglu, O. Borekci, and A. Haridas.
Water Resources Research, Vol. 19, No. 2, p 523-528, April, 1983. 7 Fig, 1 Tab, 16 Ref.

Descriptors: *Aquifers, *Mathematical studies, *Drawdown, Boundary conditions, Perched aquifers, Groundwater movement, Wells.

Finite Fourier transformation techniques have been applied to transient groundwater flow equations for drawdown due to a single well pumping from a rectangular aquifer with third-kind (Cauchy) boundary conditions. Inversion of the transformed drawdowns yields solutions in the form of infinite series as functions of spatial and temporal variables. The solutions can be applied to compute the drawdowns either in a perched aquifer or in an aquifer in contact with clogged river beds. Numerical values are computed at the locations of interest to obtain three-dimensional representation of drawdown. In the response of the rectangular aquifer to a single well pumping at the center, the drawdown was shown to have the largest value at the well in all cases, as expected. Closed form solutions obtained in this study could be especially useful for the problems in which the methods of images would not be directly applicable. Analytical solutions can also sometimes be used as partial checks of numerical solutions for large-scale problems. (Baker-IVI)
W84-01331

A NOTE ON FRACTURE FLOW DISPERSION MECHANISMS IN THE GROUND,
Royal Inst. of Tech., Stockholm (Sweden). Dept. of Chemical Engineering.
I. Neretnieks.
Water Resources Research, Vol. 19, No. 2, p 364-370, April, 1983. 5 Fig, 2 Tab, 32 Ref.

Descriptors: *Geologic fractures, *Dispersion coefficient, Stratified flow, Diffusion, Sorption, Tracers, Channeling, Mathematical models.

Two mechanisms for spreading of a tracer pulse in fissured media are discussed: channeling and diffusion in the rock matrix. Dispersion has traditionally been treated as a random mechanism, comparable to diffusion. It is not quite clear if this is applicable to such geologic media as sparsely fissured rock or other stratified media. In this paper, two other mechanisms for dispersion are treated. One is stratified flow; the other is due to interaction with a solid material. A very idealized case of stratified flow is treated. A case is modeled where the medium flows in parallel channels. Each channel is assumed to consist of the space between two parallel plates. The flow is laminar. The various channel widths are assumed to be randomly distributed with a lognormal frequency distribution. This is a distribution which has been found experimentally in fissured crystalline rock. For this case, it is shown that an equivalent dispersion coefficient will increase with the distance between injection and obervation point. For this case the normal Fickian diffusion dispersion description is not applicable if the usual assumption is made that the dispersion coefficient is constant. There are several interaction mechanisms of interest between a solute and the solid material. The one treated here is the diffusion of the solute into the porous rock matrix and sorption of the inner surfaces of the matrix. This interaction will also lead to the spreading of a tracer front, in a similar way to what other dispersion mechanisms do. It is demonstrated that if the solid material has very long extension, the dispersion due to this mechanism is so large that a Fickian dispersion coefficient cannot be evaluated without explicitly accounting for this mechanism. Attempts to evaluate Fickian dispersion coefficients by the method of moments will give values which are entirely dependent on the observation accuracy of the tail. (Author's abstract)
W84-01338

THEORY OF EARTH TIDE AND BAROMETRIC EFFECTS IN POROUS FORMATIONS WITH COMPRESSIBLE GRAINS,
Waterloo Univ. (Ontario). Dept. of Earth Sciences.
G. van der Kamp, and J. E. Gale.
Water Resources Research, Vol. 19, No. 2, p 538-544, April, 1983. 1 Tab, 29 Ref.

Descriptors: *Pore pressure, *Earth tide, *Barometric effects, Groundwater movement, Geohydrology, Tides, Mathematical models, Stress, Strain.

The general three-dimensional equations for pore pressure, stress, and strain in a homogeneous porous medium with compressible grains are used to derive expressions for the response of fluid pressure to the stress changes due to earth tides and barometric loading effects. The analysis constitutes a generalization of earlier derivations. The formation is assumed to be of large extent laterally so that horizontal flow may be neglected. It is shown that vertical flow induced by the pore pressure changes can be analyzed by means of a diffusion equation. An expression for the specific storage coefficient is derived which is valid if horizontal deformations are negligible and which includes the effect of the compressibility of the solid grains. Measurements of earth tide and barometric effects constitute two in situ tests of bulk formation properties. Such measurements can therefore make an important contribution to the characterization of the hydraulic and elastic properties of a particular formation. (Author's abstract)
W84-01355

GROUNDWATER GEOCHEMISTRY AND CALCITE CEMENTATION OF THE AQUIA AQUIFER IN SOUTHERN MARYLAND,
Geological Survey, Towson, MD. Water Resources Div.
F. H. Chapelle.
Water Resources Research, Vol. 19, No. 2, p 545-558, April, 1983. 9 Fig, 2 Tab, 21 Ref.

Descriptors: *Groundwater, *Calcite, *Minerals, *Chemical composition, Aquia Aquifer, Maryland, Calcium, Manganese, Bicarbonate, Sodium, Aquifer characteristics, Cementation, Mathematical models.

The Aquia aquifer in southern Maryland exhibits three regions that are characterized by distinctly different water composition. Region I is about 42 km wide and is parallel to the outcrop area. Water in region I has relatively high calcium, magnesium, and bicarbonate concentrations and relatively low sodium concentrations. Region II, parallel to and downgradient from region I, is about 38 km wide. Water in region II is characterized by constant bicarbonate, increasing sodium, decreasing calcium, and decreasing magnesium concentrations. Region II is downgradient from region II and is characterized by low calcium, low magnesium, high bicarbonate, and high sodium concentration. The major lithologic constituents of the Aquia aquifer are quartz sand (about 55%), glauconite (about 30%), and carbonate shell material (about 8%). Heavy minerals, clay minerals, finely disseminated lignite make up about 2% of the aquifer material. Calcite cementation is commonly observed in and near the outcrop area of the Aquia. Stoichiometric chemical models were constructed based on this lithology to described the water chemistry of each region. The applicability of these models was verified by comparing predicted and observed molar ratios of dissolved species using linear regression techniques. In all cases, close matches were found between predicted and measured curves. Mass balance calculations using the verified chemical models predict a spatial distribution of calcite cementation that closely matches the observed distribution in the Aquia aquifer. This suggests that the observed calcite cementation is postdepositional in origin and has resulted from reaction of groundwater with aquifer material. (Author's abstract)
W84-01356

ANALYTICAL SOLUTION OF A PARTIALLY PENETRATING WELL IN A TWO-LAYER AQUIFER,
California Univ., Berkeley. Lawrence Berkeley Lab.
I. Javandel, and P. A. Witherspoon.
Water Resources Research, Vol. 19, No. 2, p 567-578, April, 1983. 7 Fig, 19 Ref. DE-AC03-76SF00098.

Descriptors: *Partially penetrating wells, *Layered aquifers, Pumping tests, Mathematical studies, Drawdown, Well yield.

The behavior of a two-layer aquifer pumped by a partially penetrating well is a matter of considerable interest. Analytical solutions are developed for drawdowns in either layer and are evaluated numerically to illustrate some typical cases. The validity of the solutions is demonstrated by comparison with the limiting single-layer case and with results from finite element calculations. Asymptotic solutions for small and large values of time are developed to show that (1) at early times with partial penetration the behavior of the pumped layer is exactly the same as that of a single layer and (2) at large values of time a semilog plot of drawdown versus time yields a straight line whose slope is only a function of the sum of the two transmissivities. A method is proposed for the interpretation of pump test data. (Author's abstract)
W84-01358

2G. Water In Soils

ISOTOPIC INVESTIGATION OF A NEAR-SURFACE GROUNDWATER SYSTEM,
Heidelberg Univ. (Germany, F.R.). Inst. fuer Umweltphysik.
S. K. Gupta.
Hydrological Sciences Journal, Vol. 28, No. 2, p 261-272, June, 1983. 4 Fig, 12 Ref.

Descriptors: *Tritium, *Deuterium, *Oxygen isotopes, *Groundwater dating, Precipitation, Radioisotopes, Mathematical models, Environmental tracers, Evapotranspiration, Aquifers, Aeration zone, *Isotope, Soil moisture, German Federal Republic, Rhine Valley.

The distribution of environmental tritium, deuterium and oxygen-18 in the unsaturated zone and the underlying sandy phreatic aquifer was studied throughout 1981 in an area of high pine forests in the Rhine valley near Heidelberg. The observed vertical distribution of isotopes in the unsaturated zone can be satisfactorily explained by the combined use of a multi-cell model for moisture transport and an evapotranspiration model. The distribution in the underlying aquifer of the tracer input at the water table obtained using this method is found by replacing the total vertical diffusion coefficient in the diffusion equation with the dispersion coefficient. In this way observed tritium profiles are satisfactorily simulated for the period 1966-1981. The stable isotope profile in the unsaturated zone however remains largely unexplained due to inadequate data on the stable isotope content of precipitation over the investigated area. (Author's abstract)
W84-01102

DROUGHT ANALYSIS AND SOIL MOISTURE PREDICTION,
Eidgenoessische Technische Hochschule, Zurich (Switzerland). Versuchsanstalt fuer Wasserbau, Hydrologie und Glaziologie.
For primary bibliographic entry see Field 3F.
W84-01149

OPTIMUM MOISTURE CONTENT FOR COMPACTING SOILS: ONE-POINT METHOD,
Irrigation Research Inst., Lahore (Pakistan).
I. H. Hamdani.
Journal of Irrigation and Drainage Engineering, Vol. 109, No. 2, p 232-237, June, 1983. 3 Fig, 1 Tab, 3 Ref.

Descriptors: *Cohesive soils, *Soil compaction, Soil water, Soil density, Mathematical studies.

A one-point method for finding out Proctor Standard compacted maximum dry density and optimum moisture content of cohesive soils has been developed. It omits the usual laborious procedure of compaction test and requires only the determination of dry density of soil at 9% moisture content from which the maximum dry density and thereafter optimum moisture content can be found out. The method, therefore, shortens the time for the determination of the variables viz. maximum dry density and optimum moisture content for any given soil. On the basis of experimental data collected at the Irrigation Research Institute, Lahore (Pakistan), some mathematical relationships have been developed to compute the value of maximum dry density and optimum moisture content based on dry density of soil compacted at 9% moisture in a Proctor mold. (Author's abstract)
W84-01151

ASSESSMENT OF EVAPORATION FROM BARE SOIL BY INFRARED THERMOMETRY,
Arizona Univ., Tucson. Dept. of Soils, Water and Engineering.
J. Ben-Asher, A. D. Matthias, and A. W. Warrick.
Soil Science Society of America Journal, Vol. 47, No. 2, p 185-191, March-April, 1983. 5 Fig, 2 Tab, 15 Ref.

Descriptors: *Soil water, *Evaporation, Wind speed, Infrared thermometry, Energy, Infrared imagery, Remote sensing.

A method is described to estimate daily soil water evaporation from a drying uniform bare soil. The method involves wind speeds (u) and midday infrared thermometric measurements of surface temperatures of the drying soil (Td) and a nearby reference dry soil (To). Calculation of evaporation is made using a linear function of (To-Td) and u derived from basic energy balance considerations. An experiment was conducted in Tucson, Arizona, to compare lysimeter-measured values of evaporation with those estimated on the basis of the method. Three lysimeters (0.5 by 0.5 by 0.12 m) containing uniform soil were used in this experiment. One was kept wet (steady-state saturation), one was air dry, and one was initially wetted and allowed to dry during a 21-d interval in December 1981. Results showed a good agreement, r(2)= 0.61, between the theoretical and measured values. The method is proposed for use in studies of field variability of soil water evaporation and is amenable to the utilization of remotely sensed data. (Author's abstract)
W84-01162

PHENOLOGICAL PATTERNS OF CHIHUAHUAN DESERT PLANTS IN RELATION TO THE TIMING OF WATER AVAILABILITY,
New Mexico State Univ., Las Cruces. Dept. of Biology.
P. R. Kemp.
Journal of Ecology, Vol. 71, No. 2, p 427-436, July, 1983. 2 Fig, 2 Tab, 40 Ref.

Descriptors: *Available water, *Desert plants, *Phenology, Timing, Species diversity, Photosynthesis, Seasonal variation, Soil water, Drought, Grasses, Forbs, Shrubs, Precipitation.

Phenology, density, and cover of plant species occurring in a single Chihuahuan desert habitat were studied for 2 yr as a function of habitat moisture with the objective of relating plant species diversity to water partitioning. Much of the temporal variation in growth and phenology between species was correlated with differences in life form and photosynthetic pathway. The annual plant species consisted of a winter-spring group containing only species with the C3 photosynthetic pathway which utilize the moisture from frontal storms of winter, and a summer group containing a large majority of species with the C4 photosynthetic pathway which utilize the moisture from convectional storms of late summer. The perennial plant species consisted of C3 and C4 forbs, C4 grasses, C3 shrubs and CAM shrubs. The C3 forbs showed greatest activity in spring or autumn while the C4 forbs and grasses were most active in the summer and autumn. The C3 shrubs and CAM shrubs were active at various times from spring to autumn and not as dependent as the other groups on available soil moisture. There was above average precipitation in late summer and autumn during the first year of study and an early and prolonged drought in autumn of the second year. Some species of perennial C3 forbs and C4 grasses responded to the abundant precipitation of the first autumn with increased density or cover in the second year, but there was little change in the shrub species. The drought in the second year caused a reduction in the number of species and individuals of both C3 and C4 annual plants. The results suggest that the high species diversity in this habitat is partly a result of the different life form and photosynthetic pathway groups, each being adapted for utilizing a particular phase of the seasonally and yearly variable water. (Author's abstract)
W84-01178

ELEMENTS RETURNED TO FOREST FLOOR IN TWO RAINFOREST AND THREE PLANTATION PLOTS IN TROPICAL AUSTRALIA,
Commonwealth Scientific and Industrial Research Organization, Hobart (Australia). Div. of Forest Research.
H. M. Brasell, and D. F. Sinclair.
Journal of Ecology, Vol. 71, No. 2, p 367-378, July, 1983. 2 Fig, 6 Tab, 40 Ref.

Descriptors: *Rainfall, *Cycling nutrients, Potassium, Calcium, Magnesium, Sodium, Litter, Rain forests, Forest soils.

Returns of potassium, calcium, magnesium and sodium to the forest floor in rainfall, throughfall, litterfall and branchfall were compared for tropical rainforest and adjacent plantations of Araucaria cunninghamii at two sites with contrasting rainfall and soil fertility. At one site a plantation of Flindersia brayleyana was also compared. At each site, the input of potassium was highest in the rainforest plots. The addition of sodium was higher at the wetter site, and was mostly derived from rainfall. Estimates of the loss of dry weight and elements from the litter layer, based on the relationship between litterfall and the standing crop of litter n the forest floor, were greater in the rainforest plots than in the Araucaria plantations. The annual rate of litter disappearance (k, the quotient of the annual litterfall to the mean amount of litter on the forest floor) ranged from 0.69 for the Araucaria plot to 1.25 for the rainforest plot at the same site. (Author's abstract)
W84-01179

BEHAVIOR OF CHROMIUM IN SOILS. VI. INTERACTIONS BETWEEN OXIDATION-REDUCTION AND ORGANIC COMPLEXATION,
Vermont Agricultural Experiment Station, Burlington.
B. R. James, and R. J. Bartlett.
Journal of Environmental Quality, Vol. 12, No. 2, p 173-176, April-June, 1983. 5 Fig, 2 Tab, 7 Ref.

Descriptors: *Tannery wastes, *Chromium, *Solubility, *Chelation, *Manganese, Toxicity, Oxidation.

Initial oxidation rates of different forms of Cr(III) added to an Aquic Udorthent soil, and the maximum Cr(VI) levels observed, decreased in the order: freshly-precipitated Cr(OH), is greater than Cr-citrate is greater than aged Cr(OH)3. The oxidation of Cr(III) in tannery sewage sludge and in tannery effluent added to a Typic Eutrochrept soil also was studied as a function of time and loading rate. Amounts of Cr(VI) formed increased with Cr(III) added from 0.025 to 6.2 mmol per 100 g soil (29 to 7,200 kg per ha) for sewage sludge Cr(III), and from 0.1 to 1.8 mmol per 100 g soil (103 to 2,100 kg per ha) for the tannery effluent Cr(III). Levels of water-soluble Cr(VI) increased for a month in most of the treatments, despite the presence of reducing agents in the soil and in the wastes. Adding citric acid to the soil along with the tannery wastes increased the amount of Cr(VI) formed at each treatment level, and decreased the Cr(III) loading rate required for observation of oxidation. Mutual facilitation of Cr(III) oxidation by chelation and of further chelation by oxidation was postulated as a possible mechanism for the continuous formation of Cr(VI) in a soil. The reduction of soluble Cr(VI) in unlimed (pH 5.3) and limed (pH 6.5) samples of an Ultic Hapludalf resulted in the formation of soluble organic complexes of Cr(III) if citric acid was added with the Cr(VI). During a 9-d incubation period, more reduction of Cr(VI) occurred in unlimed than in limed samples, but higher levels of soluble Cr(III)-chelate were measured in the limed treatments. Increasing the ratio of citrate to Cr(VI) increased the rate of reduction of the CR(VI) in the Aquic Udorthent. Soluble Cr(III)-chelate formed, and the length of time the Cr(III) remained soluble also increased with the citrate/Cr ratio. (Author's abstract)
W84-01202

VERTICAL INFILTRATION OF WATER INTO UNSATURATED SOILS WITH VARIABLE DIFFUSIVITY AND CONDUCTIVITY,
Thessaloniki Univ., Salonika (Greece). School of Technology.
P. K. Tolikas, D. K. Tolikas, and C. D. Tzimopoulos.
Journal of Hydrology, Vol. 62, No. 1-4, p 321-332, April, 1983. 2 Fig, 7 Ref.

Descriptors: *Soil water, *Infiltration, Diffusion coefficient, Permeability coefficient, Wetting front, Mathematical models.

A simple approximate analytical solution to the problem of vertical infiltration of water into unsaturated soils is presented. The soil-water diffusivity as well as the hydraulic conductivity are assumed to be exponential functions of the soil-water content. Constant-concentration conditions are assumed at the boundary. The infinite-domain problem is reduced to a finite-domain problem under the assumption of an abruptly terminating wetting front coinciding with the inflection point of the soil-water content profile. The location as well as the soil-water content at the inflection point are calculated and the result is employed for the approximate solution of the problem. Numerical results obtained by the theory of this paper are compared with those obtained by Philip's method.

There is excellent agreement especially in the position of the wetting front. (Moore-IVI)
W84-01219

SOIL-WATER RESIDENCE TIME AND SOLUTE UPTAKE; 2. DYE TRACING AND PREFERENTIAL FLOW PREDICTIONS,
Sheffield Univ. (England). Dept. of Geography.
S. T. Trudgill, A. M. Pickles, and K. R. J. Smettem.
Journal of Hydrology, Vol. 62, No. 1-4, p 279-285, April, 1983. 4 Tab, 10 Ref.

Descriptors: *Soil water, *Preferential flow, Rainfall intensity, Soil saturation, Soil solution, Tracers.

The occurrence of preferential flow, by-passing soil peds, is predicted from the occurrence of rainfall intensities in excess of pedal sorption; depth of preferential tracer penetration is estimated from the displacement of this excess through a small operational volume of preferential flow, theta sub f to theta sub f values are estimated from column drainage experiments to lie between 0.01 and 0.03 cu cm/cu cm for rainfall intensities from 1 to 10 mm/hr, increasing to about 0.1 cu cm/cu cm at saturation. Observed tracer penetration is compared with predicted tracer penetration and mean profile theta sub f values are calculated. The preferential flow calculations discussed provide a useful approximation for characterizing field tracer behavior. (Author's abstract)
W84-01220

SURFACE SOIL MOISTURE VARIATION ON SMALL AGRICULTURAL WATERSHEDS,
Virginia Univ., Charlottesville. Dept. of Environmental Sciences.
M. E. Hawley, T. J. Jackson, and R. H. McCuen.
Journal of Hydrology, Vol 62, No. 1-4, p 179-200, April. 1983. 4 Fig, 4 Tab, 28 Ref.

Descriptors: *Soil water, *Agricultural watersheds, Topography, Vegetation, Soil type, Cropland, Rangeland, Hydrologic models, Statistical analysis, Oklahoma.

Surface soil moisture content is a state variable that is either simulated or required as input for many hydrologic models. In distributed hydrologic modeling, the watershed system is subdivided into spatial elements that should be as homogeneous in hydrologic response as possible. In this study, the variation of surface soil moisture was examined because soil moisture is a major factor in determining hydrologic response. The influence of variations in land cover, soil properties and topography on surface soil moisture was investigated. Statistical analysis showed that topography was the most important factor controlling the distribution of soil moisture within the small agricultural watersheds at Chickasha, Oklahoma. The presence of vegetation tends to diminish the soil moisture variations caused by topography, while the effects of minor variations in soil type were usually insignificant. Comparison of variograms developed for nearly flat cropland watersheds and more sloping rangeland watersheds indicated that a much denser network of sampling points would be required to develop soil moisture maps of a given accuracy on the rangeland watersheds. For many modeling purposes, the subdivision of low-slope cropland watersheds into spatial units of homogeneous hydrologic response can be based on topography alone. (Author's abstract)
W84-01225

EVALUATION OF THE HYDRODYNAMIC DISPERSION COEFFICIENT USING LEACHED FRACTION EQUATIONS,
Central Soil Salinity Research Inst., Karnal (India).
R. N. Pandey, and S. K. Gupta.
Journal of Hydrology, Vol. 62, No. 1-4, p 313-319, April, 1983. 2 Fig, 1 Tab, 9 Ref.

Descriptors: *Saline soils, *Hydrodynamic dispersion coefficient, *Leaching, Soil porosity, Hydrodynamics, Soil management.

The movement of various chemicals in porous media with dispersion is of interest during reclamation of saline soils. The hydrodynamic dispersion coefficient is one of the parameters used to predict the salt movement. A new approach is presented for determining the hydrodynamic dispersion coefficient, D. Equations were derived for predicting the leached fraction of salts for a particular salt-water system. Using these equations, relations for evaluating D for a step input and an initial state with uniformly distributed salts were derived and tested. The results indicate that predictions made using this approach are similar to earlier approaches. Also predictions of leached fractions of salts made using these parameters are in close proximity to observed values. (McKeon-IVI)
W84-01232

MODELING INFILTRATION INTO CRUSTED SOILS BY THE GREEN-AMPT APPROACH,
Agricultural Research Service, Durant, OK. Water Quality and Watershed Research Lab.
L. R. Ahuja.
Soil Science Society of America Journal, Vol. 47, No. 3, p 412-418, May-June, 1983. 4 Fig, 19 Ref.

Descriptors: *Soil surfaces, *Infiltration, *Soil crusts, Interfaces, Mathematical models, Soil water, Hydraulic resistance, Soil saturation, Unsaturated flow.

The study deals with infiltration of water through a stable surface crust, wherein the water content at the crust-soil interface increases with time for a long period, and remains below the saturated value. An approximate Green-Ampt-type formulation derived from a physical basis, containing a time-dependent capillary drive term and a profile shape factor, is evaluated by comparisons to a similarity solution and a finite-difference numerical solution of the problem. The exact nature of the derived Green-Ampt formulation is established for early to intermediate stages for certain reasonable conditions. Calculations of cumulative infiltration with time made by the above approach, with the profile shape factor set equal to unity, were within tolerable error from the numerical solution results for one soil and a set of experimental data for another. A previously reported piecewise application of the conventional form of the Green-Ampt equation is also developed to enable its use from time zero, as an independent predictive method. This method, which includes some implicit correction for the profile shape, gave slightly better calculations of the cumulative infiltration. The above simple methods should also be applicable to related unsaturated flow problems, such as infiltration through a transient crust-seal resistance and into a layered soil having a fine material overlying a course material. (Author's abstract)
W84-01254

EXPERIMENTAL VERIFICATION OF A MODEL TO PREDICT SOIL MOISTURE AND TEMPERATURE PROFILES,
R. J. Lascano, and C. H. M. van Bavel.
Soil Science Society of America Journal, Vol. 47, No. 3, p 441-448, May-June, 1983. 8 Fig, 6 Tab, 26 Ref.

Descriptors: *Soil water, *Soil temperature, Mathematical models, Simulation, Energy, Spatial variability, Soil layers.

A model was used to calculate water and temperature profiles over 30 d for a bare soil profile, using the hydraulic characteristics of the soil and standard meteorological data as input. The model was also used to determine the spatial variability of the calculated values, using the concept of similar media. The calculated profiles were compared to actual measurements, made periodically over the same period of time. The predicted water content values for different soil layers were within 1 standard deviation of the average measured values. The predicted temperature profiles were within 1 C of the measured values. The estimate of the spatial variability of the calculated values of water content was comparable to the variance of the measured values. Hence, it is concluded that the model was adequate to its purpose, under the conditions of the verification made. (Author's abstract)
W84-01255

INFLUENCE OF VELOCITY ON HYDRODYNAMIC DISPERSION DURING UNSTEADY SOIL WATER FLOW,
Commonwealth Scientific and Industrial Research Organization, Canberra (Australia). Div. of Environmental Mechanics.
W. J. Bond, and D. E. Smiles.
Soil Science Society of America Journal, Vol. 47, No. 3, p. 438-441, May-June, 1983. 2 Fig, 14 Ref.

Descriptors: *Hydrodynamics, *Unsteady flow, *Soil water, Mathematical studies, Velocity, Dispersion, Unsaturated flow, Solute transport, Constant flux absorption, Soil adsorption capacity.

A recent solution of the equation for hydrodynamic dispersion during unsaturated, unsteady soil water flow is extended to include the velocity dependence of the dispersion coefficient. The effect of this velocity dependence on the solute concentration profiles is illustrated for the case of horizontal constant concentration absorption of water by an initially dry soil. The application of the theory to other soil water flow situations, including constant flux absorption, is also examined. (Author's abstract)
W84-01256

LEACHING CHARACTERISTICS OF A STONY DESERT SOIL,
Volcani Inst. of Agricultural Research, Bet-Dagan (Israel). Inst. of Soil and Water.
D. Russo.
Soil Science Society of America Journal, Vol. 47, No. 3, p 431-438, 1983. 6 Fig, 2 Tab, 27 Ref.

Descriptors: *Leaching, *Desert soils, *Soil water, *Pressure potential head, Permeability coefficient, Infiltration rate, Conductivity, Soil solution, Dispersion, Stony soils.

The leaching characteristics of a stony desert soil were studied. The functional relationships between pressure potential head and gravimetric water content for the different soil layers were determined in the laboratory under drying conditions using samples in which the stony fractions (>2 mm) were excluded. These gravimetric water content values were converted to field volumetric water contents, using the field-measured values of the field bulk density and the stone fraction (on a mass basis). For a given pressure potential head, volumetric water content decreased with depth. Unsaturated soil hydraulic conductivity functions for the different soil depths were determined by the transient drainage profile method, using tensiometers and the appropriate soil water characteristics functions. The saturated hydraulic conductivities were estimated from the steady-state infiltration rate and the appropriate hydraulic head gradients. Measured saturated hydraulic conductivity values decrease with soil depth while for a given pressure potential head, the unsaturated hydraulic conductivity increases with depth. A leaching experiment was conducted in the field, by operating a sprinkler system at a rate of 7.6 mm/h. The time variations of the electrical conductivity (EC) of the soil solution as well as the concentrations of Na(+), Ca(2+), Mg(2+), Cl(-), and SO4(2-) were recorded by extracting soil solution samples from four soil suction probes located at a depth of 0.45 m and spaced 12 by 12 m apart. The initial average EC of 165 dS/m was reduced to 7.5 dS/m as 800 mm of water were applied to the soil. This final value of the EC of the soil solution is three times higher than the EC of the irrigation water, as a result of the presence of gypsum and relatively high ESP in the solid phase of the soil profile. Measured values of the EC of the soil solution were used to estimate the value of the dispersity for longitudinal dispersion, lambda. The resulting, lambda = 2.91 cm is in relatively good agreement with published field data of lambda for another soil, but is much smaller than the value of the equivalent field-scale dispersivity calculated for two different soils. (Author's abstract)
W84-01257

SIMPLE MEASUREMENTS OF SOIL SURFACE MICRORELIEF CHARACTERISTICS,

South Dakota State Univ., Brookings. Dept. of Plant Science.
E. M. White.
Water Resources Bulletin, Vol. 19, No. 2, p 231-233, April, 1983. 1 Fig, 2 Tab, 4 Ref.

Descriptors: *Soil surfaces, *Topography, *Surface runoff, Surface water storage, Roughness coefficient, Natural slope, Microrelief.

Soil surface roughness and the topographic orientation of microrelief influence runoff and water storage. Distances measured following the surface of the microrelief and horizontally across the area with the microrelief can be used with the number of microridges or microhills to estimate the average cross-sectional areas of the depressions, the microslope angles, and crest heights. Microridge sideslope angles which affect the rate of runoff were estimated reasonably well in field plots by the method. (Author's abstract)
W84-01282

AQUIC MOISTURE REGIMES IN SOILS WITH AND WITHOUT LOW CHROMA COLORS,
Texas A and M Univ., College Station. Dept. of Soil and Crop Sciences.
M. J. Vepraskas, and L. P. Wilding.
Soil Science Society of America Journal, Vol. 47, No. 2, p 280-285, 1983. 6 Fig, 4 Tab, 17 Ref.

Descriptors: *Soil water, *Soil saturation, *Water table fluctuations, Redox potential, Chroma colors, Perched water table, Iron compounds, Groundwater, Aquic moisture regimes, Soil organic matter.

Four seasonally saturated Alfisols along a toposequence 56 km north of Houston, Texas, were studied to determine if each soil had an aquic moisture regime. Water table fluctuations were monitored weekly during 1978 and 1979, and oxidation-reduction (redox) potentials and groundwater Fe contents were monitored weekly during 1979 only. Water tables of soils on backslope and toeslope positions were perched and rose to the surface during periods of heavy rainfall. Water tables of lowland soils were probably permanent, and their rise lagged behind those of the uplands soils by as much as 3 months. Redox potentials ranged from -200 to +900 mV across the toposequence during the year. Anaerobic conditions existed in each soil for variable periods. The periods when redox potentials (at a depth of 75 cm) were sufficiently low to reduce Fe(III) compounds generally increased from 6 to > 197 cumulative days from upper to lower topographic positions. Groundwater Fe contents were low, ranging between 0.1 and 2.7 ppm . Apparently little Fe reduction occurs in this landscape, because organic matter levels are low (< 1.0%). On the basis of the water table and redox potential measurements, each soil was considered to have significant periods of saturation and reduction with 75 cm of the surface. Low chroma (< 2) colors were not found in horizons (at a depth of 75 cm) which were reduced for 120 cumulative days, but color chromas were 3 or less along ped surfaces and ped interiors had mottles with chromas of 4 or more. Limitations of the low (< 2) chroma color criterion commonly used to identify aquic moisture regimes are discussed. Recommendations for use of color chromas of 3 or less for identification of aquic moisture regimes are proposed. (Author's abstract)
W84-01298

A SOIL AND ATMOSPHERIC BOUNDARY LAYER MODEL FOR EVAPOTRANSPIRATION AND SOIL MOISTURE STUDIES,
Computer Sciences Corp., Silver Spring, MD.
P. J. Camillo, R. J. Gurney, and T. J. Schmugge.
Water Resources Research, Vol. 19, No. 2, p 371-380, April, 1983. 9 Fig, 5 Tab, 18 Ref. NAS5-24350.

Descriptors: *Soil water, *Evapotranspiration, *Computer models, Remote sensing, Energy, Soil temperature, Thermal conductivity, Aerodynamic roughness, Air-soil interfaces.

A computer model of the upper soil and lower atmosphere boundary layer has been developed for use with remotely sensed data. It includes both energy and moisture balances, and it uses a predictor/corrector integrator with an automatically changing time step; these two components make the model both stable and efficient. It is driven by surface heat and moisture fluxes computed from standard meteorological data. Remotely sensed surface temperature and soil moisture can be compared to model estimates for calibration. The model has been tested using 44 hours of data from a bare soil site. Using daily maximum surface temperatures for calibration, estimated hourly surface temperatures agreed with measurements to better than 1 K. The results are insensitive to the soil heat capacity and most sensitive to the thermal conductivity and aerodynamic roughness. By varying these within physically reasonable limits, bounds on daily evaporation of 3.2 mm and 3.8 mm were estimated. (Author's abstract)
W84-01339

ESTIMATING PROFILE WATER STORAGE FROM SURFACE ZONE SOIL MOISTURE MEASUREMENTS UNDER BARE FIELD CONDITIONS,
Lockheed Engineering and Management Services Co., Inc., Houston, TX.
L. M. Arya, J. C. Richter, and J. F. Paris.
Water Resources Research, Vol. 19, No. 2, p 403-412, April, 1983. 8 Fig, 2 Tab, 25 Ref.

Descriptors: *Profile water storage, *Soil water, Mathematical models, Simulation, Soil surfaces, Irrigation, Corn, Surface flux, Remote sensing, Cultivation.

A linear regression approach was used to estimate profile water storage from the storage in the surface zone. For a given thickness of the surface zone the correlations between the surface zone and profile water storages decreased as the profile depth increased; for a given profile depth, these correlations increased as the surface zone thickness increased. In general, the correlations were higher for irrigated corn fields than for bare fields. Results show that the profile depth for which water storage can be predicted from surface zone soil moisture data depends on the thickness of the surface zone, the cultural condition of the field, and the coefficient of determination considered adequate. An alternative procedure to estimate water storage in a deep profile under bare field conditions is based on the assumption that change in profile water storage over a period of time equals net surface flux over the same time. Surface fluxes are computed from surface zone soil moisture data and hydrologic properties of the soil. In a simulation study, net surface fluxes very nearly equaled changes in water storage of a 2.25-m-deep profile. For a field-measured data set, computed surface fluxes and those measured by a weighing lysimeter showed good overall agreement. (Author's abstract)
W84-01341

UNSATURATED FLOW IN SPATIALLY VARIABLE FIELDS; 1. DERIVATION OF MODELS OF INFILTRATION AND REDISTRIBUTION,
Tel-Aviv Univ. (Israel). School of Engineering.
G. Dagan, and E. Bresler.
Water Resources Research, Vol. 19, No. 2, p 413-420, April, 1983. 3 Fig, 16 Ref.

Descriptors: *Soil water, *Infiltration, *Redistribution, Mathematical models, Unsaturated flow, Permeability coefficient, Soil water suction, Water flux, Vertical flow.

Models of water flow in the upper soil layer of spatially variable fields are developed. Field variability is assumed to take place in the horizontal plane. The saturated hydraulic conductivity is assumed to be a random variable of lognormal distribution, and head suction and moisture content are related to it by simple analytical relationships. The aim of study is to derive the expectation and variances of the moisture content, suction heads, hydraulic conductivity, and water flux as functions of depth and time for infiltration and redistribution. Toward this aim a simplified solution of vertical flow in a homogeneous column, based on the concept of moving front, is developed. The statistical procedure for using this solution in a spatially variable field is outlined. (Author's abstract)
W84-01342

UNSATURATED FLOW IN SPATIALLY VARIABLE FIELDS; 2. APPLICATION OF WATER FLOW MODELS TO VARIOUS FIELDS,
Agricultural Research Organization, Bet-Dagan (Israel). Volcani Center.
E. Bresler, and G. Dagan.
Water Resources Research, Vol. 19, No. 2, p 421-428, April, 1983. 5 Fig, 12 Ref.

Descriptors: *Soil water, Unsaturated flow, Mathematical models, Infiltration, Redistribution, Permeability coefficient, Wetting front, Hydraulic properties.

The method of modeling water flow during infiltration and redistribution formulated in part 1 of this study has been applied to compute expectations and variances of a few water flow variables and of effective hydraulic properties. Two spatially variable soils with different degrees of variation have been investigated. The expectations and variances are obtained by using the statistical averaging procedure and probability density function (pdf) of saturated hydraulic conductivity Ks. The stationarity hypotheses and the requirement that the integral scale of Ks is much smaller than the length scale characterizing the field in the x, y plane have been adopted. An approximate solution which assumes the concept of a wetting front and uniform water content is used for the statistical averaging procedure. A comparison of these results with data computed by a more accurate numerical solution to Richard's equation shows that the approximate simplified models lead to a quite accurate value of the expectations and variances of the flow variables when the field is sufficiently heterogeneous. It is suggested that in spatially variable fields, stochastic modeling represents the actual flow phenomena more realistically and provides the main statistical moments (mean, variances) by using simplified flow models which can be used with confidence in applications. The field effective hydraulic properties have been defined and derived by using approximate models. It is shown that effective properties may be meaningful only under very restricted and special conditions, such as steady gravitational flow. They do not exist in the general case of infiltration-redistribution. It is concluded that the traditional deterministic approach for solving the flow equations cannot be justified for solving flow problems in spatially variable fields. (Author's abstract)
W84-01343

UNSATURATED FLOW IN SPATIALLY VARIABLE FIELDS; 3. SOLUTE TRANSPORT MODELS AND THEIR APPLICATION TO TWO FIELDS,
Volcani Inst. of Agricultural Research, Bet-Dagan (Israel). Inst. of Soil and Water.
E. Bresler, and G. Dagan.
Water Resources Research, Vol. 19, No. 2, p 429-435, April, 1983. 4 Fig, 15 Ref.

Descriptors: *Solute transport, *Unsaturated flow, Soil water, Infiltration, Redistribution, Interstitial water, Wetting front, Salts, Mathematical models, Simulation.

An approximate model of salt transport in a spatially variable field during infiltration and redistribution is presented. The water flow is assumed to be vertical, and both pore water velocity and depth of wetting front change in the horizontal plane due to the variability of soil hydraulic properties. The salt transport in the vertical profile is computed by using an approximate, closed form solution of the convection-dispersion equation, with the value of the dispersivity increasing from zero to its maximum (3 cm) as the front propagates downward. The concentration profiles vary in the horizontal plane because of the aforementioned variation of water flow variables. The expectation value and the variance of the concentration are computed as

function of depth and time for two variable soils (Panoche, with large variability, and Bet Dagan, with lesser variability). The results are compared with those based on a numerical simulation of the water flow and salt transport, as well as with those pertaining to an equivalent, deterministic. uniform soil (for the expected value). The approximate model yields quite accurate results when compared with the numerical simulations for the field of large variability, while some differences are present for the more uniform one. The results for the expected value, based on the traditional approach of replacing the variable field by an equivalent uniform one, include a much larger error. In spite of the apparent complexity, the statistical moments of salt concentration in a spatially variable field can be determined by using simple flow models. Therefore further refinement of models of transport in homogeneous columns does not seem to be warranted, and the research effort should be concentrated on the study of field variability. (Moore-IVI)
W84-01364

GENERAL SOIL VOLUME CHANGE EQUATION: I. THE TWO-PARAMETER MODEL,
Departamento Nacional de Plantas Oleaginosas, Cordoba (Spain).
J. V. Giraldez, G. Sposito, and C. Delgado.
Soil Science Society of America Journal, Vol. 47, No. 3, p 419-422, May-June, 1983. 5 Fig, 3 Tab, 13 Ref.

Descriptors: *Soil water, *Soil volume, Mathematical models, Air entry, Soil physics, saturation.

A physically based equation containing two adjustable parameters (the slope of the load line and the air-entry water content) is proposed to describe the volume of a swelling soil as a function of its water content. This equation was shown to give an excellent representation of 18 sets of soil volume change data for both laboratory and field measurements. In many cases, a satisfactory description of volume changes could be obtained by setting the slope of the load line equal to the specific volume of liquid water and adjusting only the value of the air-entry water content. The proposed equation should be useful in computer models of water movement in swelling soils. (Author's abstract)
W84-01399

2H. Lakes

NUTRIENT LOADING ESTIMATES FOR LAKES,
Geological Survey, Sacramento, CA.
For primary bibliographic entry see Field 5B.
W84-01111

ALLUVIAL-RIVER RESPONSE TO NEOTECTONIC DEFORMATION IN LOUISIANA AND MISSISSIPPI,
Colorado State Univ., Fort Collins. Dept. of Earth Resources.
A. W. Burnett, and S. A. Schumm.
Science, Vol. 222, No. 4619, p 49-50, May, 1983. 5 Fig, 12 Ref. EAR-7727573.

Descriptors: *Alluvial rivers, *Channel morphology, Tectonics, Floodplains, Sinuosity, Gradient, Channel behavior, Geomorphology, Deformation, Louisiana, Slopes, Mississippi.

Information on channel pattern (sinuosity), gradient, depth, and channel behavior was collected for five rivers crossing the Monroe uplift and three rivers crossing the Wiggins uplift. Repeat geodetic surveys demonstrate that both structures are active, and the response of the alluvial rivers that cross the uplifts provides evidence of modern deformation. There are deformed Quaternary terraces, which indicate long-term deformation in the valleys of the alluvial rivers that cross these structures, and there are floodplain and channel convexities that provide evidence of modern deformation. In addition, the channels show significant variations of morphology (sinuosity, gradient, and depth) and behavior appropriate to reaches of increased and decreased valley slope. These alluvial rivers are adjusting to modern deformation and their adjustment confirms two geodetic leveling anomalies. (Moore-IVI)
W84-01165

SILICON CONSUMPTION AND POPULATION DENSITY CHANGES OF DOMINANT PLANKTONIC DIATOMS IN LAKE CONSTANCE,
Konstanz Univ. (Germany, F.R.). Limnological Inst.
U. Sommer, and H.-H. Stabel.
Journal of Ecology, Vol. 71, p 119-130, March, 1983. 4 Fig, 2 Tab, 20 Ref.

Descriptors: *Silicon, *Diatoms, Lake Constance, Seasonal variation, Population density, Succession.

Interactions between silicon concentration and diatom growth have been studied in Lake Constance with data on number and volume of cells per unit volume of water and concentration of dissolved reactive silicon. Concentration of dissolved reactive silicon was found to decrease markedly during the spring and summer growth period of diatoms in 1979 and 1980. Amounts of silicon taken up per cell and per unit cell volume have been calculated from the changes in silicon concentration and the increases in population density for several diatom species. The silicon to cell quotient (mg per million cells) varied over a wide range from 0.005 for Stephanodiscus hantzschii to 0.72 for Synedra acus, while that of silicon per unit cell volume (mg/cu mm) varied over a narrower range from 0.10 for Stephanodiscus hantzschii and Fragilaria crotonesis to 0.36 for Synedra acus. A four-compartment model, that allows estimates of the rates of growth and of loss of diatom populations to be calculated, is outlined. Summer succession from Asterionella formosa to either Fragilaria crotonensis (in 1979) or Stephanodiscus binderanus (in 1980) is explained by interspecific differences in the effects of silicon concentration on growth and death. For Asterionella formosa, silicon depletion did not stop cell-division but led to the death of most of the population. For Fragilaria crotonensis and Stephanodiscus binderanus cell division stopped but cells did not die and population growth continued after the concentration of dissolved silicon had increased again. (Author's abstract)
W84-01181

EFFECTS OF ORGANIC MATTER ADDITIONS TO SEDIMENT ON THE GROWTH OF AQUATIC PLANTS,
Army Engineer Waterways Experiment Station, Vicksburg, MS. Environmental Lab.
J. W. Barko, and R. M. Smart.
Journal of Ecology, Vol. 71, No. 1, p 161-175, March, 1983. 6 Fig, 6 Tab, 68 Ref.

Descriptors: *Aquatic plants, *Organic matter, *Sediments, Submerged plants, Emergent plants, Growth, Nutrients, Organic carbon, Decomposing organic matter.

Growth of three completely submerged species (Elodea canadensis, Hydrilla verticillata, and Myriophyllum spicatum) and three partly emergent species (Myriophyllum aquaticum, Potamogeton nodosus and Sagittaria latifolia) was examined on a control sediment and on the same sediment to which different types of plant organic matter (two labile and three refractory) had been added. With the addition of 5% organic matter, growth varied with the nature of the addition and the species of plant. Growth of emergent species was generally less inhibited than that of submerged species on sediment receiving this low level of addition. With greater additions of organic matter, growth of both H. verticillata and P. nodosus was severely inhibited irrespective of the nature of the addition. Labile organic matter (5% addition) inhibited growth of H. verticillata to a decreasing extent with time. In contrast, sediments receiving a 5% addition of refractory organic matter remained inhibitory to this species for at least 14 weeks. Growth was unrelated to concentration of Fe, Mn or PO4 in the interstitial water of sediments. However, low concentration of N in both interstitial water and plant shoots suggested possible N limitation of growth on sediment receiving refractory organic matter. Growth of H. verticillata on sediment with refractory organic matter added in a separate experiment was, however, unaffected by N addition to either the sediment, or water, or both. Growth of all species was negatively correlated with mean dissolved organic carbon (DOC) concentration in the interstitial water of the sediments. Growth inhibition may have resulted from the accumulation of toxic, soluble organic carbon compounds during anaerobic decomposition. The lesser inhibition of emergent plants compared with the submerged plants may have been due to the greater rhizosphere-oxidixing abilities of the former. The possible role of organic accretion in sediments was considered in relation to patterns of aquatic plant distribution and succession. (Author's abstract)
W84-01183

PHYTOPLANKTON PRODUCTION AND WINTER MIXING: CONTRASTING EFFECTS IN TWO OLIGOTROPHIC LAKES,
Department of Scientific and Industrial Research, Taupo (New Zealand). Ecology Div.
W. F. Vincent.
Journal of Ecology, Vol. 71, No. 1, p 1-20, March, 1983. 8 Fig, 9 Tab, 34 Ref.

Descriptors: *Mixing, *Phytoplankton, *Productivity, Seasonal variability, Thermal stratification, Light, Biomass, Photosynthesis, Nutrients, Limnology, Oligotrophic lakes, Storms, Nitrogen, Phosphorus, New Zealand.

Two deep oligotrophic lakes in the center of North Island, New Zealand, shared several limnological features but differed in their seasonal patterns of algal production. Lake Waikaremoana followed, in its thermal stratification, the classic pattern for temperate warm-monomictic lakes. During winter circulation, light availability to the phytoplankton was reduced by a factor of at least 13 relative to that in spring and summer, and there was no increase supply of phosphorus, which later controlled the amount of growth of its phytoplankton. Concentrations of algal biomass and algal production rates were predictably low, but rose rapidly with increased irradiance in spring. Lake Taupo experienced similar thermal stratification and mixing, but concentrations of algal biomass and algal photosynthetic production rose to maxima for the year during winter isothermy when temperatures were at their annual minimum and when mixing extended to the bottom of the lake. Winter circulation brought an increased supply of phosphorus and, more importantly, nitrogen which later controlled the amount of algal growth in the euphotic zone. This increased availability of potentially limiting nutrients offset the effects of low light availability and low temperature. Lake Taupo, and other nearby lakes which behave similarly, form intermediates between temperate lakes with typical winter minima of algal production and many tropical lakes which experience maximum phytoplankton production during storm-induced mixing. (Author's abstract)
W84-01185

ON THE ENVIRONMENTAL ISOTOPE METHOD FOR DETERMINING THE WATER BALANCE COMPONENTS OF SOME LAKES,
Institute of Physics and Nuclear Techniques, Krakow (Poland).
A. Zuber.
Journal of Hydrology, Vol. 61, No. 4, p 409-427, March, 1983. 6 Fig, 1 Tab, 23 Ref.

Descriptors: *Hydrologic budget, *Isotope studies, *Lakes, Isotopic tracers, Oxygen isotopes, Deuterium, Lake evaporation.

The paper deals with the isotope balance method applied to lakes, which can be assumed as being under steady-state conditions. It is shown that the long-term averages and non-normalized temperatures can be used in the balance equations. The applicability of the proposed approach was tested by the interpretation or reinterpretation of several

known case studies (Chala, Titicaca, Waid, Burdur, Beysehir and Egridir lakes). An isotope study of a small artificial lake (1,200,000 cu m) is presented and compared with whole-body tracing by K3(60)Co(CN)6. This artificial tracer does not appear useful for long-term tracing of surface waters. The water balance equation for each of the lakes considered was solved with the aid of the isotope balance equation of O18. Applying the calculated components of the water balance, the isotope balance equation of deuterium was solved for finding the values of kinetic enrichment for deuterium. These values, which give the fit of the evaporation lines to the experimental data, do not agree with the values known from direct laboratory experiments, thus they have to be treated as apparent values, which may be useful for future field work. (Author's abstract)
W84-01214

OBSERVATIONS OF TRANSPORT TO SURFACE WATERS FROM A PLUNGING INFLOW TO LAKE MEAD,
California Univ., Berkeley. Dept. of Civil Engineering.
H. B. Fischer, and R. D. Smith.
Limnology and Oceanography, Vol. 28, No. 2, p 258-272, 1983. 13 Fig, 6 Ref.

Descriptors: *Lake Mead, *Plunging inflow, *Mixing, Nutrients, Salinity, Wave action, Internal waves, Thermocline, Algal growth, Hydrodynamics, Seiches, Water temperature, Water circulation.

Algae growing in the surface water of Las Vegas Bay, an arm of Lake Mead, may receive nutrients contained in the stream entering through Las Vegas Wash. The stream water is more dense than the lake water due to dissolved salts. Existing hydrodynamic theory predicts that the stream should form a submerged layer isolating the nutrients from the surface. The theory was tested by introducing dye into the stream during two 14-day experiments; salinity, temperature, and dye concentration were monitored in the inner portion of the bay. Significant dye concentrations were found in the surface waters during both experiments, and two modes of internal waves with amplitudes up to 6 m were observed. The wave motion provided the main mechanism for transport to the surface in the first experiment; in the second an additional mechanism was the creation and destruction of temporary thermoclines due to meteorological variation. An approximate nutrient balance shows that in each case about 10% of the entering nutrients were available to the surface water within the 14-day period of the experiments. (Author's abstract)
W84-01244

TEMPERATURE, HEAT, AND MIXING IN LAKE VALENCIA, VENEZUELA,
Colorado Univ. at Boulder. Dept. of Environmental, Population, and Organismic Biology.
W. M. Lewis, Jr.
Limnology and Oceanography, Vol. 28, No. 2, p 273-286, 1983. 5 Tab, 28 Ref. DEB7604300, DEB7805342, DEB8003883.

Descriptors: *Water temperature, *Mixing, Lake Valencia, Venezuela, Weather, Stratification, Water circulation, Heat budget, Eddy diffusion, Seasonal variation, Wind, Thermal stratification, Lake evaporation.

Water temperature profiles, weather data, and lake level data spanning a 2-yr period for Lake Valencia, Venezuela (10 degrees N, 67 degrees W), are used in an analysis of thermal regime, mixing, and heat flux. The lake, which has an area of 350 sq km and mean depth of 19 m, is warm monomictic; it becomes isothermal annually near the end of November, at the onset of the dry season. The water column during stratification consists of an upper mixed layer, which averages 13 m but varies greatly in thickness, followed by alternating thick layers of positive and negligible density gradients. The number of layers changes through time. Vertical eddy diffusivites during stratification vary from 0.23 cu cm/s at 20 m to 0.09 at 35 m. The mean annual heat budget is 5,308 cal/sq cm. Evaporative heat loss and net radiation flux are the two largest heat budget elements; net back radiation and sensible heat loss are important secondary terms. Seasonality, is principally traceable to heat budget terms influenced by minimum air temperature, whereas week-to-week variation is influenced by other terms as well. Maximum stability of the water column is about 350 g-cm/sq cm with little variation between yr. Work of the wind in distributing heat is 2,630 g-cm/sq cm for 1977 and 3,156 in 1978. Stability responds in a significant way to weather changes, even during stratification. (Author's abstract)
W84-01245

THE CHEMICAL COMPOSITION OF LAKES IN THE NORTH-CENTRAL UNITED STATES,
Minnesota Univ., Minneapolis. Dept. of Agriculture and Applied Economics.
E. Gorham, W. E. Dean, and J. E. Sanger.
Limnology and Oceanography, Vol. 28, No. 2, p 287-391, 1983. 11 Fig, 1 Tab, 43 Ref. GS23309, GB2448, GB6018, GB18800.

Descriptors: *Lakes, *Specific conductivity, *Ions, Water chemistry, Climates, Glacial drift, Limnology, Geology, Arid climates, Minerals.

Lake waters of the north-central U.S.A. are classified into five groups, based on increasing specific conductivity and changes in ionic composition from east to west, from Wisconsin through Minnesota to North and South Dakota. The most dilute group of waters has specific conductivities <29 micro mhos/cm at 25 C; the most concentrated group has specific conductances that range from 7,000 to 73,000 micro mhos. As conductivity increases all major ions increase, but there is a shift in cation dominance from Ca(2+) to Mg(2+) to Na(+), and in anion dominance from HCO3(-) to SO4(2-). This shift partly reflects a westward increase in climatic aridity, and partly a westward sequence of glacial drifts from noncalcareous to calcareous and thence to calcareous with abundant sulfur-bearing minerals. Levels of pH, K, Cl, F, B, and SiO2 also show a distinct westward increase. Concentrations of NO3(-) and Mn increase from east to west, but the trend is less distinct. Concentrations of Fe vary widely without any trend over the range of conductivity. Color, mostly from dissolved organic matter, is controlled chiefly by lake depth, except for lakes with extensive peatlands in their drainage basins. (Author's abstract)
W84-01246

SPRING BLOOM IN A HYPEREUTROPHIC LAKE, LAKE KASUMIGAURA, JAPAN-III; PHYTOPLANKTON ABUNDANCE IN STANDING STOCK OF ORGANIC MATTER IN LAKE WATER,
Tsukuba Univ., Ibaraki (Japan). Inst. of Biological Sciences.
H. Seki, and A. Masaki.
Water Research, Vol. 17, No. 4, p 453-457, April, 1983. 8 Fig, 1 Tab, 12 Ref.

Descriptors: *Eutrophication, *Phytoplankton, *Organic matter, Eutrophic lakes, Particulate matter, Bacterial, Detritus, Japan.

The rapid increase of phytoplankton biomass was the major process for the increase of particulate organic matter in Lake Kasumigaura in 1980. During the first phytoplankton pulse in the bloom relative abundance of each component of organic matter in the lake water was: dissolved organic matter 100, phytoplankton 28, bacteria 27, and detrital particle 27. This relative abundance was maintained as a steady-state oscillation throughout the spring bloom similar to that usually observed in moderately eutrophic waters. Thus phytoplankton abundance in the standing stock of organic matter of the hypereutrophic water during the spring bloom does not show any marked difference from that of moderately eutrophic waters. (Author's abstract)
W84-01268

SPRING BLOOM IN A HYPEREUTROPHIC LAKE, LAKE KASUMIGAURA, JAPAN-II; SUCCESSION OF PHYTOPLANKTON SPECIES,
Tsukuba Univ., Ibaraki (Japan). Inst. of Biological Sciences.
Y. Hara, A. Tsuchida, and H. Seki.
Water Research, Vol. 17, No. 4, p 447-451, April, 1983. 3 Fig, 2 Tab, 12 Ref.

Descriptors: *Eutrophication, *Phytoplankton, *Succession, Population dynamics, Eutrophic lakes, Japan.

Numerous phytoplankton species in Lake Kasumigaura were shown to comprise the Spring bloom in 1980. The predominant phytoplankton species that appeared during the Spring bloom belonged to 28 genera. A few species among them increased at any time to form a phytoplankton pulse, but the few species of phytoplankters that comprised a phytoplankton pulse did not exclude completely other phytoplankters. During the Spring bloom, one pulse was replaced by another pulse composed of a new grouping of different species. Throughout these replacements by natural selection in the bloom were numerous other species by phytoplankters at levels of abundance somewhat less than those which formed phytoplankton pulse. (Author's abstract)
W84-01269

SPRING BLOOM IN A HYPEREUTROPHIC LAKE, LAKE KASUMIGAURA, JAPAN-I; SUCCESSION OF PHYTOPLANKTERS WITH DIFFERENT ACCESSORY PIGMENTS,
Tsukuba Univ., Ibaraki (Japan). Inst. of Biological Sciences.
H. Seki, and E. Takahashi.
Water Research, Vol. 17, No. 4, p 441-445, April, 1983. 7 Fig, 21 Ref.

Descriptors: *Eutrophication, *Pigments, *Phytoplankton, *Chlorophyll, Seasonal variations, Eutrophic lakes, Succession, Japan.

Phytoplankters appearing during the spring bloom of 1980 in Lake Kasumigaura were classified into three groups characterized by different accessory pigments. Phytoplankters of the first group possess phycocyanin, those of the second group possess chlorophyll b, and those of the third group possess chlorophyll c. Only eucaryotic phytoplankters, belonging to the second or third group, were predominantly present during the bloom. Predominance of the second and third groups alternated during the bloom as individual phytoplankton pulses. The relationship between the population density of all phytoplankters and the abundance of phytoplankters possessing chlorophyll c could be expressed as a highly significant regression curve ($r=0.7997$) throughout the spring bloom in Tsuchiura Harbor: $Y=102.9e^{(-0.03138x)} + 29.04$, where X is the concentration of chlorophyll a in all phytoplankters in lake water, and Y is the percentage of chlorophyll a possessed by phytoplankters possessing also chlorophyll c. (Author's abstract)
W84-01270

DIATOM EVIDENCE FOR RECENT ACIDIFICATION OF TWO SCOTTISH LOCHS,
University Coll., London (England).
R. J. Flower, and R. W. Battarbee.
Nature, Vol. 305, No. 8, p 130-133, September, 1983. 2 Fig, 1 Tab, 28 Ref.

Descriptors: *Diatoms, *Acid lakes, *Dating, Lake sediments, Scotland, Hydrogen ion concentration, Catchment areas.

Claims that highly acid (pH <5.0), often fishless lakes have become so as a result of recent (mainly twentieth century) acidification processes have not been fully validated because there are few acid lakes that have been the subject of long-term continuous monitoring. However, diatom analysis of Pb-210 dated sediment cores can provide the detailed historical perspective required. These techniques are used to show that some lakes in the UK have become strongly acidified within the past 130 yr. Analysis of cores from two lakes in Galloway, south-west Scotland, indicate that both lakes, one with an unafforested catchment and one with a

recently afforested catchment, have experienced pH declines of approximately 1 pH unit (from about pH 5.5 to 4.5) during this time. (Author's abstract)
W84-01302

NATURAL SHORT-CIRCUITING OF INFLOW TO OUTFLOW THROUGH SILVER LAKE, NEW YORK,
State Univ. of New York at Buffalo. Dept. of Biology.
J. P. Englert, and K. M. Stewart.
Water Resources Research, Vol. 19, No. 2, p 529-537, April, 1983. 10 Fig, 2 Tab, 41 Ref.

Descriptors: *Water circulation, Lakes, Silver Lake, New York, Water level, Short-circuiting, Outlets, Inlets, Mixing, Retention, Nutrients.

The proximity of the major inlet to the outlet of Silver Lake, New York, permits some short-circuiting of the incoming flow. This feature, unusual to document in lakes, is verified with data which show times when the inlet and outlet waters resemble each other more than they do the lake. Rhodamine dyes and some natural inorganic chemical variables have been used as tracers to illustrate this phenomenon. The case for short-circuiting appears less clear during some low inflows and is complicated by water level manipulation at a small dam on the outlet and withdrawal of water from the lake by communities. The significance of short-circuiting for this eutrophic/mesotrophic lake is that some incoming nutrients from the rich agricultural watershed bypass the lake. Determinations of retention time and nutrient loading for such lakes are more complex. The governance of trophic conditions in this and similar lakes, or in parts of some lakes, may be influenced more by such incomplete mixing than generally considered. (Author's abstract)
W84-01354

SENSITIVITY TO ACIDIFICATION OF LAKES IN THE FLAT TOPS WILDERNESS AREA, COLORADO,
Geological Survey, Lakewood, CO.
J. T. Turk, and D. B. Adams.
Water Resources Research, Vol. 19, No. 2, p 346-350, April, 1983. 3 Fig, 3 Tab, 8 Ref.

Descriptors: *Alkalinity, *Lakes, Colorado, Acid rain, Mountain lakes, Altitude, Buffering, Watersheds, Neutralization, Dilution, Drainage area.

The use of regionally plentiful coal and oil shale resources in the western United States may result in an increase of atmospheric emissions in and upwind of northwestern Colorado, as may smelting and an increase in population. Such emissions have been previously associated with water quality degradation from acid rain. Lakes of the Flat Tops Wilderness Area in northwestern Colorado are sensitive to acidification if precipitation in the area becomes as acidic as that of the northeastern United States. About 50% of the titration alkalinity in the most poorly buffered lakes is from dilution of the titrant acid rather than neutralization. Alkalinity is readily predicted from watershed characteristics including lake altitude, fraction of exposed bedrock, and drainage area. Alkalinity values as small as 70 micro eq/l occur in the higher-altitude lakes. On the basis of alkalinity titration curves for the lakes studied, an alkalinity of 200 micro eq/l or greater is necessary to adequately protect a lake from precipitation as acidic as that of the northeastern United States. Most lakes at altitudes of 3380 m or greater are predicted to have alkalinity values of 200 micro eq/l or less. About 370 lakes having a total surface area of about 157 ha are calculated to be sensitive to acidification. (Moore-IVI)
W84-01361

SEASONAL LIMNOLOGICAL CHANGE AND PHYTOPLANKTON PRODUCTION IN OHAKURI, A HYDRO-ELECTRIC LAKE ON THE WAIKATO RIVER,
Department of Scientific and Industrial Research, Taupo (New Zealand). Div. of Marine and Freshwater Sciences.
G. W. Coulter, J. Davies, and S. Pickmere.
New Zealand Journal of Marine and Freshwater Research, Vol. 17, No. 2, p 169-183, June, 1983. 8 Fig, 4 Tab, 35 Ref.

Descriptors: *Limnology, *Phytoplankton, Nutrients, Chlorophyll a, Seasonal variation, Flow rate, Water temperature, Stratification, Biomass, Nitrates, Phosphorus, Hydroelectric power, Reservoir operation, Environmental effects, Primary productivity, Lake Ohakuri.

The Waikato River originates in oligotrophic Lake Taupo, but becomes chemically enriched before reaching Lake Ohakuri, where phytoplankton increases dramatically. Data were collected over 2 years, including daily measurement for 1 year of N, P, Si, and chlorophyll a in water leaving the lake. The hypolimnion remained stagnant in summer, and inorganic-N peaked after lake overturn. NO3-N showed a marked seasonal cycle in concentration and total flux in water leaving the lake, which may not correspond with input rates from the catchment. Melosira granulata var. angustissima dominated the phytoplankton in summer, and Chlamydomonas spp. and Cyclotella spp. in winter. In summer, weekly cycles in algal abundance, which correlated inversely with NO3-N and DRP (dissolved reactive phosphorus) concentrations, were dictated by weekly flow cycles resulting from the requirements of hydro-electric power generation. Flow rate and temperature appear the dominant factors regulating phytoplankton abundance. Shorter residence time and probably slower growth rates in winter, and longer residence and more rapid growth in summer interact critically. Phytoplankton production in river lakes such as Ohakuri with a brief water residence time is more appropriately represented by the mass flow of algal material through it than by the abundance of the standing stock. Summer phytoplankton biomass in Lake Ohakuri is equivalent only to a mildly eutrophic condition, but the amount generated and then lost from the lake is equivalent to production in a lake of much higher trophic status in a closed basin. (Author's abstract)
W84-01372

RESPONSE OF PLANKTONIC ROTIFERS TO THE EUTROPHICATION PROCESS AND TO THE AUTUMNAL SHIFT OF BLOOMS IN LAKE BIWA, JAPAN. I. CHANGES IN ABUNDANCE AND COMPOSITION OF ROTIFERS,
Polish Academy of Sciences, Warsaw. Inst. of Ecology.
A. Hillbricht-Ilkowska.
Japanese Journal of Limnology, Vol. 44, No. 2, p 93-106, April, 1983. 5 Fig, 6 Tab, 21 Ref.

Descriptors: *Eutrophication, *Rotifers, Lake Biwa, Plankton, Seasonal variation, Diatoms, Chlorophyta, Water temperature, Foods.

The density of planktonic rotifers in Lake Biwa was 100-3,000/l from September to December, 1980. This level is remarkably higher than that previously reported by Yamamoto, who noted no more than 10-600/l, although the northern basin (LBN) has been, in general, regarded as having lower values than the southern basin (LBS). An increase in population density was observed in the following species: small and fine particle feeders like Keratella cochlearis, Collotheca pelagica, Brachionus species group and K. quadrata; and graspers such as Polyarthra vulgaris and P. dolichoptera. The long-term changes may well be evidence for the accelerated eutrophication of Lake Biwa. The actual trophic difference between both basins in reflected in 1) greater abundance of rotifers (maximum of 3,000/l); 2) greater contribution of K. cochlearis (especially f. tecta = 50%); and 3) higher Trophic State Index (TSI = 75) in the LBS; on the contrary, corresponding values were 300/l, K. cochlearis f. tecta = 1% and TSI = 46, respectively, in the LBN. During the autumnal shift of the blooms from green algae to diatoms coupled with the autumnal cooling of the water there was a succession of dominant species with food selection of different size particles: K. cochlearis, Polyarthra spp., K. quadrata. In November, a considerable increase in the number of K. cochlearis f. tecta was recognized. (Author's abstract)
W84-01373

RESPONSE OF PLANKTONIC ROTIFERS TO THE EUTROPHICATION PROCESS AND TO THE AUTUMNAL SHIFT OF BLOOMS IN LAKE BIWA, JAPAN. II. CHANGES IN FECUNDITY AND TURNOVER TIME OF THE DOMINANT SPECIES,
Polish Academy of Sciences, Warsaw. Inst. of Ecology.
A. Hillbricht-Ilkowska.
Japanese Journal of Limnology, Vol. 44, No. 2, p 107-115, April, 1983. 1 Fig, 5 Tab, 12 Ref.

Descriptors: *Rotifers, *Eutrophication, Lake Biwa, Seasonal variation, Reproduction, Water temperature, Plankton, Foods, Detritus, Algae.

The egg-female ratio, i.e. the ratio of the numbers of amictic eggs to the number of females was analyzed for the dominant species, Keratella cochlearis, K. quadrata and Polyarthra vulgaris together with P. dolichoptera from September to December 1980 at six stations in the southern part of Lake Biwa. Irrespective of the decrease in water temperature from about 26 C in September to about 6 C in December, there was a considerable increase in the fecundity of these species in November. It was probably the effect of the temporal improvement of the food conditions, i.e., the increased detritus particles and nanoplanktonic algae. The birth rates were calculated as well as the tentative number of parthenogenetic generations for each sampling interval and for the whole sampling period; it ranged from 15 to 29 generations for K. cochlearis, 12-30 for P. dolichoptera and P. vulgaris, and 2-12 for K. quadrata, varying for each stations. (Author's abstract)
W84-01374

IMPACT ON DAPHNIA PULEX OF PREDATION BY YOUNG YELLOW PERCH IN ONEIDA LAKE, NEW YORK,
E. L. Mills, and J. L. Forney.
Transactions of the American Fisheries Society, Vol. 112, No. 2A, p 154-161, March, 1983. 2 Fig, 2 Tab, 26 Ref. F-17-R.

Descriptors: *Predation, Population dynamics, Daphnia, Perch, Biomass, Fish food organisms, Oneida Lake, New York.

The response of a Daphnia pulex population to fluctuations in abundance of young (age-0) yellow perch Perca flavescens was examined in Oneida Lake, New York, 1975-1979. Comparisons of yellow perch biomass and D. pulex abundance suggested daphnid populations could tolerate predation by 10 kg of young fish/hectare but reproduction could not compensate for predation when biomass of young exceeded 20-40 kg/hectare. Consumption by young yellow perch exceeded D. pulex production in 1975 and 1977, when daphnids disappeared, but maximum daily consumption was less than 27% of production in 1976 when daphnids were abundant through late summer. Since 1968, D. pulex populations have persisted through late summer in years when young yellow perch were scarce and disappeared when young were abundant. The decisive role of young yellow perch in the regulation of D. pulex abundance is of importance to the broader fish community in Oneida Lake. (Author's abstract)
W84-01400

2I. Water In Plants

EFFECTS OF BIOCLIMATE AND SOIL USE ON WATER BUDGET TERMS IN WEST AFRICA (INFLUENCE DU BIOCLIMAT ET DE L'AMENAGEMENT DES SOLS SUR LES ELEMENTS DU BILAN HYDRIQUE EN AFRIQUE DE L'OUEST),
Office de la Recherche Scientifique et Technique Outre-Mer, Paris (France).
For primary bibliographic entry see Field 2A.
W84-01104

EFFECT OF WATER-TABLE DEPTH ON SHOOT GROWTH, ROOT GROWTH, AND NODULATION OF MYRICA GALE SEEDLINGS,
Harvard Univ., Petersham, MA. Harvard Forest.
C. R. Schwintzer, and S. A. Lancelle.
Journal of Ecology, Vol. 71, No. 2, p 489-501, July, 1983. 5 Fig, 2 Tab, 31 Ref. DE777-02249.

Descriptors: *Water table gradient, *Growth, Peat soils, Sand, Soil types, Nitrogen fixation, Biomass, Root development, Oxygen uptake, Phenology.

Seedlings of Myrica gale, an actinorhizal dinitrogen-fixing shrub, were grown in two boxes with a gradient of water-table depth from 3-79 cm. The boxes were outdoors but sheltered from rain by translucent roofs. One box was filled with sand and the other with peat. The seedlings were harvested in autumn shortly before leaf-fall. The plants produced maximum biomass at water-table depths between 10 cm and 35 cm on both substrata but the total amounts produced were substantially greater on peat than on sand. Shoot-root quotients decreased with increasing water-table depth on both substrata but were much larger on sand. The roots did not penetrate below the water table and the orientation of the major lateral roots changed from primarily horizontal to semi-vertical with increasing water-table depth. Nodules formed 6-7% of the total seedling biomass in the wettest soils and decreased to 1% in the driest. Nodule roots showed maximum development in the wettest soils where they were relatively long and thick, and emerged through the surface into the air above. This is consistent with a functional role in enhancing nodule oxygen uptake under oxygen-limiting conditions. The considerable phenotypic plasticity in response to moisture and aeration exhibited by M. gale appears to be a valuable adaption in its natural habitat where the water level often fluctuates. (Author's abstract)
W84-01177

SOME RELATIONSHIPS BETWEEN ENVIRONMENTAL RELIABILITY AND SEED DORMANCY IN DESERT ANNUAL PLANTS,
New Mexico State Univ., Las Cruces. Dept. of Biology.
K. E. Freas, and P. R. Kemp.
Journal of Ecology, Vol. 71, No. 1, p 211-217, March, 1983. 1 Fig, 1 Tab, 20 Ref.

Descriptors: *Desert plants, *Rainfall, Germination, Seasonal variation, Model studies, Seeds, Water controlled dormancy, Ecology.

There are two groups of annual species that grow in the northern Chihuahuan Desert of North America. Plants in one group germinate and complete their life cycle in late summer. Those in the other germinate in winter or early spring and complete their life cycle in the spring. The late summer season is characterized by abundant and reliable rain, while the winter-spring season has less abundant and less reliable rain. Several theoretical models have been suggested which predict that annual plants from uncertain environments may or may not have evolved innate dormancy to offset the possibility of population extinction due to complete germination followed by complete mortality under severely unfavorable conditions. These models were tested with a comparative experiment examining the germination responses of seeds collected from an annual species which grows during the more reliable summer season and two annual species which grow during the less reliable winter-spring season. The summer annual species does not have a genetically fixed innate dormancy, but the two winter annual species apparently have evolved a genetically controlled innate dormancy. All three annual species exhibited environmentally-controlled seed dormancy with respect to amount of rainfall. Seeds germinated only when the equivalent of more than 10 mm of rain fell. Above 15 mm of simulated rain, germination was positively correlated with increasing amount of rain in all three species. The importance of innate dormancy, water-controlled dormancy, and seed dispersal to the long-term survival of these species is discussed. (Author's abstract)
W84-01182

DISCRIMINATION OF GROWTH AND WATER STRESS IN WHEAT BY VARIOUS VEGETATION INDICES THROUGH CLEAR AND TURBID ATMOSPHERES,
Agricultural Research Service, Phoenix, AZ. Water Conservation Lab.
R. D. Jackson, P. N. Slater, and P. J. Pinter, Jr.
Remote Sensing of Environment, Vol. 13, No. 3, p 187-208, July, 1983. 19 Fig, 2 Tab, 17 Ref. 12-14-5001-38.

Descriptors: *Remote sensing, *Reflectance, *Water stress, Wheat, Drought, Satellite technology, Optical properties, Vegetation, Simulation.

Reflectance data were obtained over a drought-stressed and a well-watered wheat plot with a hand-held radiometer having bands similar to the MSS bands of the Landsat satellites. Data for 48 clear days were interpolated to yield reflectance values for each day of the growing season, from planting until harvest. With an atmospheric path radiance model and Landsat 2 calibration data, the reflectances were used to simulate Landsat digital counts (not quantized) for the four Landsat bands for each day of the growing season, through a clear (= 100-km meteorological range) and a turbid (= 10-km meteorological range) atmosphere. Several ratios and linear combinations of bands were calculated using the simulated data, then assessed for their relative ability to discriminate vegetative growth and plant stress through the two atmospheres. The results showed that water stress was not detected by any of the indices until after growth was retarded, and the sensitivity of the various indices to vegetation depended on plant growth stage and atmospheric path radiance. (Author's abstract)
W84-01505

THE INFLUENCE OF SNOW ON GROWTH AND SURVIVAL OF PLANTED TREES,
Eidgenoessisches Inst. fuer Schnee- und Lawinenforschung, Davos (Switzerland).
W. Frey.
Arctic and Alpine Research, Vol. 15, No. 2, p 241-251, May, 1983. 10 Fig, 5 Tab, 37 Ref.

Descriptors: *Snow cover, *Trees, Plant water potentials, Water stress, Seedlings, Subalpine zone, Dessication, Flushing.

In the subalpine zone at Davos, Switzerland, a trial plot of seven tree species was kept artificially snow free during two winter periods and compared with an equivalent trial plot under natural snow cover. Periodic measurements of water potential and water content showed that, during the winter period, there is a higher water stress in the snow free plants, especially Norway spruce (Picea abies (L.) Karst), and deciduous species, including European larch (Larix decidua Mill.). Seedlings of these species showed serious desiccation and an increased mortality compared with the snow-covered seedlings. Desiccation occurred predominantly on the parts of the snow-free seedlings that were exposed to the sun. Flushing in spring was retarded in the snow-free plot. All measured growth parameters showed more favorable results in the snow-covered plot. Sufficient snow cover is therefore a very important factor for the success of young seedlings in the subalpine zone, especially for Norway spruce, European larch, and deciduous broadleaf species. (Author's abstract)
W84-01382

2J. Erosion and Sedimentation

ANALYSIS METHOD FOR STUDYING SEDIMENTATION PATTERNS,
Coastal Engineering Research Center, Fort Belvoir, VA.
J. R. Weggel.
Journal of Waterway, Port, Coastal and Ocean Engineering, Vol. 109, No. 2, p 256-260, May 1983. 4 Fig.

Descriptors: *Sediment distribution, *Shoals, *Scour, *Water depth, Navigation channels, Harbors, Estuaries, Rivers, Dredging, Bathymetry, *Florida, Mill Cove, St. Johns River.

It is often necessary to quantify changes in water depth brought about by either sedimentation or scour in enclosed or semi-enclosed water bodies. Historical sedimentation patterns can be used to estimate future patterns and then used to determine future dredging requirements for river, harbor, and estuary navigation channels. Comparison of two area vs. depth curves provides a method for determining the depths in which sedimentation and scour are occurring. The area between two such curves divided by the time difference between the two surveys for which the curves are constructed will give the shoaling or scour rate. Shoaling or scour rates can be determined as a function of water depth simply by taking the difference between the ordinates of the two curves divided by the time between the two surveys for any given water depth. This analysis can provide insight into sedimentation trends for enclosed for semi-enclosed water bodies that routine plots of bathymetric changes cannot. Mill Cove, a semi-enclosed basin adjacent to the St. Johns River in Florida, is used as an example. (Moore-IVI)
W84-01061

DETERMINATION OF THE CROSS SECTION OF CANAL CHANNELS FOR SEDIMENT TRANSPORT,
For primary bibliographic entry see Field 8B.
W84-01068

MOVEMENT OF FINE GRAINS IN THE VICINITY OF WELL SCREENS,
Vizgazdalkodasi Tudomanyos Kutato Intezet, Budapest (Hungary).
For primary bibliographic entry see Field 8B.
W84-01101

SEDIMENT SUSPENSION WITH RIPPLED BED,
Saitama Univ. (Japan). Dept. of Foundation Engineering.
For primary bibliographic entry see Field 8B.
W84-01131

SUSPENDED SEDIMENT PROFILE FOR ICE-COVERED FLOWS,
Department of the Environment, Burlington (Ontario). Hydrology Div.
B. G. Krishnappan.
Journal of Hydraulic Engineering, Vol. 109, No. 3, p 385-399, March, 1983. 12 Fig, 3 Tab, 10 Ref.

Descriptors: *Suspended sediments, *Turbulent flows, *Ice cover, Free surfaces, Fall velocity, Shear velocity, Roughness coefficient, Mathematical models.

The vertical distribution of the suspended sediment in two-dimensional, uniform, and fully developed turbulent flows under ice cover is formulated using the results of the kappa-epsilon turbulence model of Launder and Spalding. Three sets of distribution curves each corresponding to a particular value of the ratio between the ice cover roughness and bed roughness are presented in a form similar to the distribution curves of H. Rouse (Trans. ASCE 102: 463, 1937) for free-surface flows. For the same value of the ratio between the shear velocity and the fall velocity of sediment particles, the relative concentration is less in ice-covered flows than in free-surface flows. Under similar conditions, the relative concentration of suspended sediment decreases as the ratio of the ice cover roughness to bed roughness increases. The agreement between the present formulation and the measurements found in the literature is favorable. (Author's abstract)
W84-01135

STEADY BED MATERIAL TRANSPORT IN ALLUVIAL CHANNELS,
Ministry of Agriculture and Water, Riyadh (Saudi Arabia).
G. Holtorff.
Journal of Hydraulic Engineering, Vol. 109, No. 3, p 368-384, March, 1983. 8 Fig, 3 Tab, 9 Ref.

Descriptors: *Sediment transport, *Alluvial channels, Fluid mechanics, Flow rates, Erosion, Suspended load, Bed load.

A theory is developed to predict the bed material load for steady fluid and sediment flow in alluvial channels, based on the fact that the total power of the fluid and sediment flow is constant. The total power of a sediment-laden stream is consumed by the flow of the fluid, the suspended load, and the bedrock. The bedrock power is the shear force attributed to the bedload in motion times the mean traveling velocity of the bedload particles. The suspended load power is the submerged weight of the particles in suspension, times their fall velocity plus the power which is caused by increased dampening of turbulence generation in the presence of heavy sediment concentrations near the channel bed. In accordance with the transport mechanism of suspended load and bedload, equations are derived that permit the prediction of the rate of sediment load provided the fluid and sediment flow is steady. The mass of the bedload particles in motion and that of the suspended load particles in suspension depends on the erosive and diffusive power of the flow, and the power of the sediment to resist. Since the erosive and diffusive power of the flow decreases as the rate of the sediment transport increases, the solution of the problem consists in defining the flow stage where the transport capacity of sediment is maximum. The theory of sediment transport outlined is well supported by experimental evidence. (Baker-IVI)
W84-01136

NONEQUILIBRIUM BEDLOAD TRANSPORT BY STEADY FLOWS,
Ministry of Works and Development, Hamilton (New Zealand). Water and Soil Science Centre.
R. G. Bell, and A. J. Sutherland.
Journal of Hydraulic Engineering, Vol. 109, No. 3, p 351-367, March, 1983. 8 Fig, 2 Tab, 21 Ref.

Descriptors: *Bed load, *Mathematical models, Gravel, Scour, Flow velocity, *Sediment transport, Erosion, Alluvial channels.

The response of a gravel bed reach to imposed steady flows is examined under nonequilibrium conditions, where the bedload inflow is zero. Experimental research to date and general mathematical models for nonequilibrium alluvial conditions are reviewed. An experimental program was designed to examine the transient bed response for different reach lengths. Also, measured nonequilibrium bedload transport rates were compared with comparable local equilibrium capacity rates at selected time intervals and distances for a common mean flow velocity. Differences occurred between nonequilibrium transport rates and comparable equilibrium capacity rates at a maximum near the beginning of the reach but diminishing towards the downstream end of the local scour hole. This spatial variation of the transport rate deficit exists because the flow requires a finite length of bed to erode sufficient bed material to satisfy its equilibrium transport capacity. Consequently, mathematical model performance will be poor in the local scour hole region. (Author's abstract)
W84-01137

SOIL WATER MATRIC POTENTIAL EFFECTS ON AGGREGATE STABILITY,
Iowa Agricultural and Home Economics Experiment Station, Ames.
P. B. Francis, and R. M. Cruse.
Soil Science Society of America Journal, Vol. 47, No. 3, p 578-581, May-June, 1983. 1 Fig, 2 Tab, 14 Ref.

Descriptors: *Soil water, *Soil aggregates, Soil management, Soil erosion, Rain, Manure, Crop production, Aggregate stability.

The effect of soil water matric potential (psi m) is not considered with most techniques utilized to evaluate aggregate stability. Rather, aggregate stability usually is measured at psi m of 0 Pa or at an unknown psi m. The objective of this study was to determine psi m effects, in the range of 0 to -3,000 Pa, on stability of natural soil aggregates obtained from a fencerow and from plots having a range of management histories. Aggregate stability, considered inversely related to the mass of soil detached by impact of falling water drops, increase markedly as psi m decreased from 0 to -500 Pa. Similar psi m changes at psi m < -500 Pa had smaller effects on aggregate stability. Significant differences in stability of aggregates obtained from plots with different cropping and/or manuring histories, were sometimes undetectable at psi m < -500 Pa but were more consistently detected at psi m = Pa. Data from this study indicate that aggregate stability is very sensitive to psi m particularly at psi m near zero. Techniques for comparing aggregate stability between soils or soil treatments should ensure equal values of psi m exist for all aggregates. Measurements made over a range of psi m should yield better comparisons of aggregate stability between soils than measurements made at one psi m. (Author's abstract)
W84-01161

SEMI-EMPIRICAL CORRELATIONS FOR FINE AND COARSE COHESIONLESS SEDIMENT TRANSPORT,
Lamar Univ., Beaumont, TX.
P. A. Mantz.
Proceedings of the Institution of Civil Engineers, Vol. 75, p 1-33, 1983. 6 Fig, 13 Tab, 28 Ref.

Descriptors: *Sediment transport, *Hydraulic resistance, *Bedform development, Bed load, Suspension, Suspended load, Flow velocity, Flow depth.

A total of 54 laboratory experiments were conducted with fine, cohesionless, silica sediment under water flow. The equilibrium sediment transport, bedform development and hydraulic resistance for three grades of almost equal-sized silica solids (of median diameter 0.018 mm, 0.042 mm and 0.123 mm) were investigated for three conditions of flow depth (0.03 m, 0.06 m and 0.12 m) and for six conditions of average flow velocity (from 0.2 to 0.7 m/s at increments of 0.1 m/s). Experiments were conducted in a 10 m long and 0.30 m wide recirculating, tilting, laboratory flume which contained direct town supply, softened water. The water chemistry was controlled so that the sediment behaved as if cohesionless, and the water temperature was allowed to reach an equilibrium maximum of about 25 C. The sediment transport was analysed according to the streampower theory developed by Bagnold. The theory was extended for these shallow flows, and it was assumed that the rate of applied flow energy was dissipated partly by the friction and moving bed load solids, partly by the turbulence associated with bedforms, partly by the gravitational settling of suspended load solids, and partly by the friction of the unimpeded flow. Unique correlations were subsequently derived for the work rates associated with the moving bed load or suspended load, and the streampower excess which excluded that necessary for incipient transport or incipient suspension. An analysis of readily available field data was made for comparison with the laboratory data. Bed load data were abstracted from a recent collation by Bagnold. The data covered a coarse-grain diameter range from 0.3 mm to 300 mm, and a large flow-depth range from 0.10 m to 12 m. Suspended load data were abstracted from river data monitored and collated by the US Geological Survey. They included both shallow and deep rivers (ranging from 0.2 m to 9 m in depth) from the States of Alaska, New Mexico and Arizona. (Author's abstract)
W84-01248

AN APPLICATION OF OPERATIONS RESEARCH METHODS TO BEACH RENOURISHMENT PROJECTS,
University of South Florida, Tampa.
E. W. Shows.
Water Resources Bulletin, Vol. 19, No. 2, p 249-253, April, 1983. 1 Tab, 6 Ref.

Descriptors: *Beach erosion, *Mathematical models, *Surveys, Florida, Erosion control, Capital costs, Recreation, Economic feasibility.

Mathematical models have been widely used in business to minimize cost and maximize profit. In this paper such models are used to help determine the optimum strategy for a beach renourishment project including the initial and subsequent fill quantities and the length of a complete renourishment cycle. The importance of considering economic factors is emphasized, and the sensitivity of the optimal values to changes in the basic parameters of the models are discussed. The possible extensions and limitations of the models are considered. (Author's abstract)
W84-01279

CONFLUENCE SCOUR IN COARSE BRAIDED STREAMS,
Alberta Univ., Edmonton. Dept. of Geography.
P. Ashmore, and G. Parker.
Water Resources Research, Vol. 19, No. 2, p 392-402, April, 1983. 10 Fig, 3 Tab, 35 Ref.

Descriptors: *Scour, *Braided streams, Abrasion, Erosion, Model studies, Confluent streams, Reynolds numbers, Sand.

Laboratory modeling was performed of confluence scour in coarse braided streams and the results were compared with field data using an appropriate scaling law. The major controls of scour depth are isolated and may be used for design predictions. The findings suggest that confluence scour in gravel braided streams can be modeled reasonably well in coarse, noncohesive bed material. Scale effects, presumably resulting from low model Reynolds numbers, are not greater than about 10%. Generally speaking, the angle of confluence is the major influence on scour depth, but the relationship is modified slightly by the relative discharge of the two channels when this difference becomes large. If one channel approaches twice the size of the other, the relationship with the angle of confluence becomes poor. For angles between 30 and 90 degrees, the relationship is almost linear. Maximum relative scour depth rarely exceeds 6.0. This relationship covers the most common naturally occurring confluence angles. The influence of bed material sorting and cohesiveness is apparent in comparing data sets from different sources. Cohesive bed material gives markedly lower depths than noncohesive material, while poorly sorted sand may give slightly lower depths than well sorted sand of the same mean size. Coarse lag material is absent from the scour holes even in poorly sorted sand. Confluence scour depth is clearly independent of valley parameters for the range of measurements reported. However, there is no reason to believe that the same scour relation should apply to such cases as large, low-slope sand bed braided streams. (Baker-IVI)
W84-01330

DENSITIES OF WET AGGREGATED SEDIMENT FROM DIFFERENT TEXTURED SOILS,
Science and Education Administration, Oxford, MS. Sedimentation Lab.
F. E. Rhoton, L. D. Meyer, and F. D. Whisler.
Soil Science Society of America Journal, Vol. 27, No. 3, p 576-578, May-June, 1983. 1 Fig, 2 Tab, 8 Ref.

Descriptors: *Sediment transport, *Soil density, *Soil aggregates, Soil texture, Sediment density, Rain, Deposition, Interstitial water.

The density of wet aggregated sediment is a major factor controlling its fluvial transport and deposition. Since this property varies depending on the volume of aggregate pores filled with water, the use of dry aggregate densities in sediment transport studies may result in significant underestimations of wet sediment densities and consequently overestimations of transport distances. Therefore, this study was conducted to measure the densities of wet aggregates that exist during fluvial transport of sediment from agricultural soils. Samples from six soils, ranging in texture from silty clay to sandy loam, were wetted and agitated to simulate the stresses of raindrop impact. Two size ranges (1.00 to 0.50, and 0.50 to 0.25 mm) were collected from this sediment by wet sieving, then drained at a suction of 50 cm of water and weighed. The sedi-

ment volume was measured to the nearest 0.05 mL in a displacement vessel. Wet aggregate densities approximated 2.0 Mg/cu m and varied little among soils, or between the two size ranges. No variations in aggregate density could be directly attributed to differences in aggregate textures. (Author's abstract)
W84-01366

2K. Chemical Processes

STUDIES ON THE ANODIC STRIPPING VOLTAMMETRY OF LEAD IN POLLUTED ESTUARINE WATERS,
Pontificia Univ. Catolica do Rio de Janeiro (Brazil). Dept. de Quimica.
For primary bibliographic entry see Field 5A.
W84-01060

LIQUID CHROMATOGRAPHIC DETERMINATION OF GLYPHOSATE IN FORTIFIED SOIL AND WATER SAMPLES,
Agricultural Research Service, Beltsville, MD. Weed Science Laboratory.
For primary bibliographic entry see Field 5A.
W84-01079

LESSONS FROM THE SILICA 'DECLINE' IN LAKE MICHIGAN,
Minnesota Univ., Minneapolis. Limnological Research Center.
For primary bibliographic entry see Field 5A.
W84-01083

MULTIELEMENTAL AND HYDROCHEMICAL STUDY OF HOLY ZAMZAM WATER,
A. Naeem, M. Y. Alsanussi, and A. A. Almuhandis.
Journal of the New England Water Works Association, Vol. 97, No. 2, p 158-169, June, 1983. 3 Fig, 3 Tab, 6 Ref.

Descriptors: *Well water, *Saudi Arabia, *Water chemistry, Drinking water, Heavy metals, Minerals, *Water analysis.

A water sample from the Zamzam Well, located in the holy city of Makkah in the Western Province of the Kingdom of Saudi Arabia, was analyzed with the help of neutron activation, inductivity coupled plasma and classical techniques. Multielement composition, the hydro-chemical properties, and the potability of the water from a chemical viewpoint are reported. A total of 34 elements have been found with calcium (Ca), magnesium (Mg), sodium (Na), and chloride (Cl) in the highest concentrations. The elements Sb, Be, Bi, Br, Co, I, Mo are < 0.01 ppm. Only traces of Cr, Mn, and Ti have been found in Zamzam water. Hydrochemical study of Zamzam water indicates that it is a sodium chloride water and of meteoritic origin. The four toxic elements arsenic (As), cadmium (Cd), lead (Pb), and selenium (Se) have been found below the danger level of human consumption. Chemically Zamzam water is suitable for drinking purposes. (Author's abstract)
W84-01095

INOSITOL-PHOSPHATES; HYDROLYSIS, STABILITY AND ANALYSIS,
Technische Hogeschool Twente, Enschede (Netherlands). Dept. of Chemical Technology.
W. Potman, and L. Lijklema.
Water Research, Vol. 17, No. 4, p 411-414, April, 1983. 4 Fig, 1 Tab, 16 Ref.

Descriptors: *Phosphates, *Bottom sediments, *Hydrolysis, Electrophoresis, Hydrogen ion concentration, Cycling nutrients, Detritus.

Inositol-phosphates are a class of phosphate-rich compounds occuring in sediments and aquatic systems. Their extraction from sediments and plant material and subsequent separation should be performed under conditions where these compounds are stable, whereas quantitative estimation of the individual components requires complete hydrolysis but without degradation of the inositol formed. The study showed that chemical hydrolysis can be performed at a low pH and 100 C. Extractions should be performed by preference in alkaline solutions at moderate temperatures. (Author's abstract)
W84-01260

TRANSLOCATION OF INORGANIC/ORGANIC MERCURY IN A MODEL AQUATIC SYSTEM,
Hyogo Prefecture Public Health Inst., Kobe (Japan).
J. Yamamoto, Y. Kaneda, Y. Hikasa, and E. Takabatake.
Water Research, Vol. 17, No. 4, p 435-440, April, 1983. 5 Fig, 4 Tab, 18 Ref.

Descriptors: *Organomercury compounds, *Bottom sediments, Spectrophotometry, Path of pollutants, Translocation, Model studies.

The volatile organic mercury at subnanogram level was determined by steam distillation Magos treatment and flameless atomic absorption spectrophotometry after preconcentration with silvered sand. By this technique, down to 0.1 ng of methyl mercury can be determined with good precision (+ or - 5%). Application of the technique to our aquatic model system made clear that much higher ratio of organic mercury (nearly 8%) to the total one was in water overlying organic sediment than the water sample overlying sandy sediment (approximately 3.5%). In natural water, therefore, it would seem that the content of organomercurials are less than 10% to that of total mercury. (Author's abstract)
W84-01271

OXYGEN ISOTYPE RATIOS IN GERMAN GROUNDWATER,
Kernforschungsanlage Juelich G.m.b.H. (Germany, F.R.). Inst. fuer Radioagronomie.
H. Forstel, and H. Hutzen.
Nature, Vol. 304, No. 18, p 614-616, August, 1983. 2 Fig, 2 Tab, 10 Ref.

Descriptors: *Oxygen isotopes, *Groundwater, Precipitation, Spatial distribution, Temperature, Altitude, Germany.

The natural variation in the O18/O16 ratio in precipitation has a characteristic global pattern, a continuous decrease from the Equator towards the polar regions, corresponding to the worldwide distribution of the local mean annual temperature. This global pattern is not, however, sensitive enough to predict the local O18/O16 ratio in precipitation. A survey of groundwater throughout the Federal Republic of Germany was obtained from about 900 samples of the municipal water supply. A multicorrelation study demonstrates that both distance from the coast and height above sea level determine the local O18/O16 ratio, and that this ratio generally decreases from the northern coast towards the southern mountainous region. The geographical variation in the O18/O16 ratio may serve as a basis for paleoclimatological, plant-physiological and food-analytical applications. (Moore-IVI)
W84-01303

SOME CHARACTERISTICS OF CHEMICAL PRECIPITATION,
State Univ. of New York at Albany. Atmospheric Sciences Research Center.
A. W. Hogan.
Tellus, Vol. 35B, No. 2, p 121-130, April, 1983. 4 Fig, 2 Tab, 13 Ref. RAD 00023.

Descriptors: *Chemical precipitation, *Rain, Sodium, Chlorides, Storms, Chemistry of precipitation, Convective precipitation, Precipitation, Ions.

Two very dissimilar cold frontal occulusions deposited 6 mm and 60 mm of rain respectively at an observatory in the rural northeastern U.S.A. Water precipitation was carefully observed, in conjunction with other meteorological parameters, through both storm systems. The concentration of several ionic substances were measured in specimens of rain water collected during meteorologically homogeneous portions of the two storms. The rate of chemical precipitation was determined with respect to water precipitation. This rate was constant during the prefrontal stage of both storms, and increased following cold frontal passage, in the convective side of the systems. Analyses of the time rate of chemical precipitation showed it to be constant during the continuous rain of April 5. Examinations of the ratio of chloride to sodium through the time history of the storms shows them to agree with a transport model postulated by Rossby and Egner (1955). Although the two storms varied considerably with respect to convectivity and prevailing flow, the total amounts of the several ions precipitated were directly proportional to the amount of water precipitated. (Author's abstract)
W84-01309

PRECIPITATION CHEMISTRY AT THE MARCELL EXPERIMENTAL FOREST IN NORTH CENTRAL MINNESOTA,
North Central Forest Experiment Station, Grand Rapids, MN. Forestry Sciences Lab.
E. S. Verry.
Water Resources Research, Vol. 19, No. 2, p 454-462, April, 1983. 4 Fig, 5 Tab, 28 Ref.

Descriptors: *Precipitation chemistry, *Rain, *Snow, Ions, Hydrogen ion concentration, Ammonium, Sodium, Calcium, Sulfates, Nitrates, Acid rain, Acidity, Alkalinity.

Concentration (milligrams and microequivalents per liter) values are presented for major ions occurring in rain and snow from July 1978 to July 1980. Ammonium, sodium, and calcium are the largest equivalent weight cations which are largely balanced by sulfate and nitrate anions. Hydrogen is the fourth most abundant cation; but high combined concentrations of other cations in 27% of the sample events mask positive correlations with high hydrogen concentrations. Field-measured pH averaged 4.3, but the range (3.5 to 6.5) fluctuated with a combination of earth and air mass conditions. When high cation (and anion) data are deleted, low pH correlates well with high nitrate. Sulfate concentrations are similar to those measured in 1936 and do not correlate with pH. Calcium and, to a lesser extent, ammonium tend to increase pH values. High nitrate values also correlate positively with high excess acidity, while high sodium and calcium values correlate with high excess alkalinity. (Author's abstract)
W84-01345

CHEMICAL COMPOSITION OF NATURAL WATERS IN THE KINASA LANDSLIDE AREA,
Nagoya Univ. (Japan). Water Research Inst.
Y. Kitano, and S. Nakamura.
Japanese Journal of Limnology, Vol. 44, No. 2, p 132-138, April, 1983. 5 Fig, 1 Tab, 10 Ref.

Descriptors: *Chemical composition, *Natural waters, *Landslides, Kinasa, Snowmelt, Sulfates, Carbon dioxide, Carbonates, Groundwater.

Waters were collected in the Kinasa landslide area to confirm whether the source of the waters was only rain and snow melt water or if deep groundwater was also present. Chloride concentration was very low and uniform. Therefore, the chemical constituents in the waters are principally related to the dissolution from rocky materials through chemical and weathering processes. Bicarbonate and sulfate concentrations of the natural waters were high and varied. It is presumed that rocky materials are weathered chemically by carbon dioxide underground. Calcium and magnesium ions were dissolved preferentially from the rocky material and carbon dioxide changes to bicarbonate ions. At that time silicate minerals change into clay minerals. The origin of carbon dioxide underground is assumed to be in the volcanic activity of the area. Calcium and magnesium concentration in natural waters may well indicate the extent of the chemical weathering of rocky materials in contact with the waters and also the extent of the formation of clay minerals. Natural waters in landslide

areas with tertiary rocks have been known to be high in sulfate concentration derived mostly through the oxidation of iron sulfides. (Baker-IVI)
W84-01376

2L. Estuaries

SALT-WATER INTRUSION IN THE NILE DELTA,
For primary bibliographic entry see Field 4B.
W84-01120

HARMONIZING GHYBEN-HERZBERG INTERFACE WITH RIGOROUS SOLUTIONS,
For primary bibliographic entry see Field 4B.
W84-01121

SHOALING PROCESSES IN NAVIGABLE WATERS,
American Society of Civil Engineers, New York. Task Committee on Causes and Effects of Shoaling in Navigable Waters.
For primary bibliographic entry see Field 8B.
W84-01130

INFLUENCE OF WATER MOTION ON THE DISTRIBUTION AND TRANSPORT OF MATERIALS IN A SALT MARSH ESTUARY,
Western Australia Univ., Nedlands. Dept. of Civil Engineering.
J. Imberger, T. Berman, R. R. Christian, E. B. Sherr, and D. E. Whitney.
Limnology and Occanography, Vol. 28, No. 2, p 201-214, March, 1983. 8 Fig, 28 Ref.

Descriptors: *Estuaries, *Salt marshes, Boundary processes, Water circulation, Fluctuations, Mixing, Nutrient cycling, Ammonium, Organic carbon, Silicates, Turbulence, Duplin River, Georgia.

A formal approach is presented of ordering the time scales of the dominant fluxes of material in an estuary and then accordingly choosing the spatial and temporal resolution of the sampling program. In this way bounds can be derived for the internal turnover times, boundary exchange rates, and import or export fluxes of a particular substance purely from measurements of the standing stock values in the estuary water. Application of this methodology to an experiment in the Duplin River, Georgia, showed that if the effects of the water motion and mixing are extracted from the variation of a biological component, then the variability of the residual can be successfully interpreted. For a typical summer condition it was shown that ammonium was cycled rapidly within the marsh water, its distribution was very patchy, and only its decomposition products left the marsh; that the refractory dissolved organic carbon (DOC) component was steadily exported by longitudinal mixing while labile DOC was rapidly recycled in the water; that silicate was produced in large amounts in the marsh and exported by longitudinal mixing; that particulate organic carbon concentrations were almost completely determined by the turbulence intensity in the water, and that compared to this internal cycling, export was of minor significance. (Author's abstract)
W84-01243

COOLING WATER DISCHARGES INTO A SEA WITH A SLOPING BED,
Central Electricity Generating Board, Leatherhead (England). Central Electricity Research Labs.
J. F. Macqueen, and R. W. Preston.
Water Research, Vol. 17, No. 4, p 389-395, April, 1983. 3 Fig, 7 Ref.

Descriptors: *Cooling water, *Powerplants, *Thermal pollution, *Tidal effects, Temperature gradient, Slopes.

Analytical solutions for the rise in background water temperatures due to the discharge of cooling water from a power station are developed. Previous work has taken account of the cooling water flow rate and temperature increase through the station, the tidal excursion and residual drift, cross-tide dispersion and heat exchange between the water and atmosphere in a sea with constant depth. The treatment in the present paper incorporates the slope of the sea bed. The mathematical feature of the analysis is that a closed form for the background (or far-field) temperature distribution is obtained in terms of confluent hypergeometric functions. The parameters which define these functions involve the site hydrographic feature and cooling water system parameters. Results are presented which indicate the sensitivity of the temperature rise to bed slope and the position of the discharge. The temperature at the shore, which may be an important ecological indicator and station design parameter, decreases as the distance of the outlet from the shore increases; the effect of the bed slope on the rate of decrease is quantified. (Author's abstract)
W84-01261

AN APPLICATION OF OPERATIONS RESEARCH METHODS TO BEACH RENOURISHMENT PROJECTS,
University of South Florida, Tampa.
For primary bibliographic entry see Field 2J.
W84-01279

GROWTH RESPONSE AND SPECTRAL CHARACTERISTICS OF A SHORT SPARTINA ALTERNIFLORA SALT MARSH IRRIGATED WITH FRESHWATER AND SEWAGE EFFLUENT,
Delaware Univ., Newark. Coll. of Marine Studies.
M. A. Hardisky, R. M. Smart, and V. Klemas.
Remote Sensing of Environment, Vol. 13, No. 1, p 57-67, March, 1983. 3 Tab, 1 Fig, 35 Ref.

Descriptors: *Spartina, *Salt marshes, *Remote sensing, Growth, Satellite technology, Biomass, Nitrogen, Spectral radiance, Salinity, Effluent, Vegetation, Optical properties, Radiance, Nutrients.

A short Spartina alterniflora salt marsh was irrigated with sewage effluent and freshwater. Vegetation response to nitrogen additions in the sewage effluent and soil salinity dilution by the freshwater was monitored spectrally with a GSFC MARK II hand held radiometer. The radiometer was spectrally configured to match bands 3, 4, and 5 of the Landsat-4 Thematic Mapper. Freshwater and sewage irrigations promoted live tissue production in the marsh until October. Control areas exhibited no net live biomass production after August. Radiance data expressed as the vegetation index and the infrared index were successfully correlated to increased live leaf biomass in the treated marsh. Significant correlations were found to exist between spectral radiance data and live leaf biomass, a live-dead leaf biomass ratio or percent live leaf biomass of the experimental areas. Successful spectral detection of biomass changes resulting from some perturbation suggests remote sensing as a viable tool for stress detection in S. alterniflora salt marshes. (Author's abstract)
W84-01299

CHESAPEAKE BAY: AN UNPRECEDENTED DECLINE IN SUBMERGED AQUATIC VEGETATION,
R. J. Orth, and K. A. Moore.
Science, Vol. 222, No. 4619, p 51-53, 7 October, 1983. 2 Fig, 21 Ref.

Descriptors: *Aquatic plants, *Submerged plants, *Chesapeake Bay, Estuarine.

Data on the distribution and abundance of submerged aquatic vegetation in Chesapeake Bay indicate a significant reduction in all species in all sections of the bay during the last 15 to 20 years. This decline is unprecedented in the bay's recent history. The reduction in one major species, Zostera marina, may be greater than the decline that occurred during the pandemic demise of the 1930's. The data used to determine the past and present distribution of bay grasses were acquired from recent aerial mapping studies, field surveys, biostratigraphical analyses of estuarine sediments for seeds and pollen of bay grasses, older archived photographs, and anecdotal information. The pattern of vegetation loss has not been uniform throughout the bay. The evidence of a major, regionally isolated change in the submerged grass communities over the last 20 years suggest that this estuarine system has been undergoing an environmental stress of major proportions. Although storms may have hastened the decline in certain sections of the bay, the overall pattern appears to be one of chronic decline that began in the upriver and upper bay areas and continues to the present. (Moore-IVI)
W84-01329

TIDAL AND LOW-FREQUENCY NET DISPLACEMENT IN A COASTAL LAGOON,
Harbor Branch Foundation, Inc., Fort Pierce, FL.
N. P. Smith.
Estuaries, Vol. 6, No. 3, p 180-189, September, 1983. 11 Fig, 16 Ref.

Descriptors: *Lagoons, *Tidal currents, Water currents, Flow, Flushing, Wind, Florida.

Four, 32-day current meter records from the Indian River lagoon, Florida, are used to characterize flow patterns along the Intracoastal Waterway in a coastal lagoon. The M2 tidal constituent amplitude decreases from 58 cm/s near the Fort Pierce Inlet to only 7 cm/s in the interior of the lagoon. The relative importance of the nontidal variance in the current meter records increases from 0.6% to 26.6% of the total over the same distance. Plots of net displacement over time intervals of one to 16 days suggest relatively rapid flushing near the inlet, but in the interior of the lagoon periods of little or no net movement are increasingly common. Low-frequency motions at all four sites are coherent with windstress over time scales in excess of approximately two days. (Author's abstract)
W84-01378

CIRCULATION CHANGES IN THE SHEEPSCOT RIVER ESTUARY, MAINE, FOLLOWING REMOVAL OF A CAUSEWAY,
Maine Univ. at Orono. Dept. of Botany and Plant Pathology.
B. J. McAlice, and G. B. Jaeger, Jr.
Estuaries, Vol. 6, No. 3, p 190-199, September, 1983. 5 Fig, 2 Tab, 16 Ref.

Descriptors: *Water circulation, *Estuaries, *Tidal currents, Salinity stratification, Gravitational circulation, Causeway, Maine.

A causeway which had restricted tidal flow in a portion of the Sheepscot River estuary was removed late in 1974. Flowmeter data from moored plankton nets fished over full tidal cycles, and salinity observations made in conjunction with the net sets, were used to evaluate the effects of causeway removal on circulation in the estuary. Tidal flows in the main channel increased by almost 50%. This increase was accompanied by substantial decreases in salinity stratification and in the strength of the gravitational circulation. (Author's abstract)
W84-01379

PRODUCTIVITY, DETRITUS FLUX, AND NUTRIENT CYCLING IN A CAREX LYNGBYEI TIDAL MARSH,
British Columbia Univ., Vancouver. Westwater Research Centre.
R. U. Kistritz, K. J. Hall, and I. Yesaki.
Estuaries, Vol. 6, No. 3, p 227-236, September, 1983. 8 Fig, 34 Ref.

Descriptors: *Sedge, *Primary productivity, *Nutrient cycling, Detritus, Tidal marshes, Estuaries, Standing crop, Biomass, Nitrogen, Phosphorus, Leaching, Nutrients, Seasonal variation, British Columbia.

Net annual primary production of a sedge Carex lyngbyei dominated tidal marsh in the Fraser River estuary, British Columbia, Canada was 634 g ash-

free dry weight (AFDW) per sq m per yr (687 g dry weight per sq m per yr). Mean maximum shoot elongation during the short (May to August) growing season was 1.88 cm per day from overwintering shoots. The maximum above-ground standing crop of 690 g AFDW per sq m represented only 25% of the total below-ground biomass, which appears to be controlling most of the critical life history processes of the sedge marsh. An estimate of 14% of the aboveground standing crop was lost through leaching of dissolved organic carbon from the growing plant. Aboveground tissue losses, which were negligible during the growing season, occurred primarily via translocation in autumn and tidal export during the winter. In situ measurements showed that of the original maximum standing crop, approximately 38%, 37%, and 25% were lost by downward translocation, tidal export, and sediment burial, respectively. Based on changes in above and belowground nutrient pools, rapid spring (May to late June) uptake rates of 109 mg N per sq m per day and 23.0 mg P per sq m per day by shoots were followed by downward translocation rates of 44.8 mg N per sq m per day and 12.2 mg P per sq m per day during late June to the end of August. Aboveground leaching rates were estimated as 23.9 mg N per sq m per day and 7.8 mg P per sq m per day and belowground uptake rates as 100 mg N per sq m per day and 26 mg P per sq m per day; root uptake occurred primarily after late June. Nutrient levels in decomposing litter more than doubled over the winter period showing a pattern of nutrient enrichment characteristic of marsh ecosystems. (Author's abstract)
W84-01380

TIDAL AND SUBTIDAL WATER VOLUME EXCHANGE IN AN ESTUARINE SYSTEM,
Louisiana State Univ., Baton Rouge. Center for Wetland Resources.
E. M. Swenson, and W.-S. Chuang.
Estuarine, Coastal and Shelf Science, Vol. 16, No. 3, p 229-240, March, 1983. 8 Fig, 1 Tab, 15 Ref. DACW29-79-R-0221.

Descriptors: *Estuaries, *Tidal effects, Velocity, Tidal prism, Water exchange, Fluctuations, Water currents, Lake Pontchartrain, Louisiana.

Estuarine water movements occur over a broad range of time scales. In this study, moored current meter data were used to investigate water volume exchange in the tidal passes of Lake Pontchartrain, Louisiana on the tidal and subtidal time scales. A calibration technique, employing cross-channel measurements of water velocity, was used to calibrate the moored current meters, thus allowing for calculation of volume flow over a 35-day period. The local diurnal tide accounted for 50% of the total volume exchange, the rest being due to subtidal events (frontal passage). This subtidal exchange occurs primarily as large-scale events characterized by volume fluxes up to six times greater than the normal tidal prism. Neglecting this subtidal component in the determination of the volume fluxes for a system such as Lake Pontchartrain, could result in substantial underestimation (by as much as 50%) of these volumes and their corresponding material fluxes. (Author's abstract)
W84-01383

SOME FEATURES OF THE DYNAMIC STRUCTURE OF A DEEP ESTUARY,
National Oceanic and Atmospheric Administration, Rockville, MD. Office of Marine Pollution Assessment.
M. Devine.
Estuarine, Coastal and Shelf Science, Vol. 16, No. 3, p 271-289, March, 1983. 3 Fig, 28 Ref.

Descriptors: *Estuaries, *Boundary layers, Mathematical models, Velocity, Salinity, Stratification, Upwelling, Mixing, River flow, Path of pollutants, Flushing, Dynamics.

A boundary layer formulation for the dynamic structure of a deep estuary is developed. Cross-stream averages are used, but the boundary layer structure is shown to depend on the cross-stream geostrophic constraint. A similarity transformation and a weighted residual method are used to derive an approximate solution for the velocity and salinity structure of the upper layer. This solution indicates that, in the central regime of the estuary, outflow extends through the entire halocline. Inflow takes place in a much less stratified lower layer, and mass exchange between the layers is by upwelling. This structure is modified in the outer regime of the estuary, where mixing between the layers develops, and in the inner regime, where a sharp halocline develops and where the dynamics are dominated by river runoff. The implications of the dynamics for the flushing process and for pollutant movement and dispersion are discussed. (Author's abstract)
W84-01384

STUDIES ON THE BEHAVIOUR OF NUTRIENTS IN THE MANDOVI ESTUARY DURING PREMONSOON,
National Inst. of Oceanography, Panaji (India).
S. N. De Sousa.
Estuarine, Coastal and Shelf Science, Vol. 16, No. 3, p 299-308, March, 1983. 8 Fig, 1 Tab, 17 Ref.

Descriptors: *Estuaries, *Nutrients, Silicates, Nitrates, Phosphates, Salinity, Mixing, Industrial wastes, Water pollution, India.

Behavior of silicate, nitrate and phosphate in the Mandovi Estuary (India) was studied during the premonsoon season. The study shows that silicate is removed from the water column while nitrate showed an internal source. This nitrate source has been identified as the wash water from an iron ore screening plant which discharges the muddy waste directly into the river. Applying mixing relations, the distribution of this nitrate both up- and downstream of the outfall has been studied. Phosphate showed very low concentrations in the low salinity region; however, its concentration increased slightly towards the higher salinity region. (Author's abstract)
W84-01385

TIDAL EXCHANGE OF NITROGEN AND PHOSPHORUS BETWEEN A MESOHALINE VEGETATED MARSH AND THE SURROUNDING ESTUARY IN THE LOWER CHESAPEAKE BAY,
Virginia Univ., Charlottesville. Dept. of Environmental Sciences.
T. G. Wolaver, J. C. Zieman, R. Wetzel, and K. L. Webb.
Estuarine, Coastal and Shelf Science, Vol. 16, No. 3, p 321-332, March, 1983. 5 Fig, 1 Tab, 24 Ref. R/ER-1.

Descriptors: *Estuaries, *Salt marshes, *Tidal exchange, *Nutrient cycling, Nitrites, Phosphorus, Nitrogen, Ammonium, Fluctuations, Seasonal variation, Wave action, Particulates, Solute transport, Sediment transport, Vegetation, Chesapeake Bay.

A 22-month study was conducted to determine the exchange of nitrogen and phosphorus between a mesohaline vegetated marsh in the Carter's Creek area of Virginia and the surrounding estuary, focusing on the role of the vegetated marsh surface in the processing of these constituents. On an annual basis there was a removal of NH4(+), PO4(3-), NO3(-), dissolved organic nitrogen, dissolved organic phosphorus, particulate nitrogen and particulate phosphorus from the tidal water as it resided on the vegetated marsh. Only nitrite was transported from the marsh to the estuary. Most of the nitrogen and phosphorus species showed distinct seasonal trends with respect to the direction of transport except nitrate and orthophosphate. The ammonium flux data indicates that this nutrient was removed from the inundating water during late spring and fall, with a slight release of this constituent into the tidal water during the late summer. The transport of nitrite was from the estuary to the marsh for most of the year except during the fall. The large release of this nutrient into the tidal water at this time is associated with the senescence of the marsh vegetation. There was a large removal of DON (dissolved organic nitrogen) from the tidal water during the fall, while the flux of DOP (dissolved organic phosphorus) was from the estuary to the marsh for most of the year except during the summer. The largest removal of particulate nitrogen and phosphorus from the tidal water occurred during the summer months when the turbidity of the tidal water was highest, especially when wave scouring of the mudflats brings material into the water column. A loss of particulate nitrogen from the marsh to the estuary was evident during the fall and winter. (Author's abstract)
W84-01386

VERTICAL MIXING AT THE HEAD OF THE LAURENTIAN CHANNEL,
McGill Univ., Montreal (Quebec). Inst. of Oceanography.
R. G. Ingram.
Estuarine, Coastal and Shelf Science, Vol. 16, No. 3, p 333-338, March, 1983. 2 Fig, 13 Ref.

Descriptors: *Estuaries, *Mixing, *Tidal effects, Water temperature, Salinity, Velocity, Nutrients, Primary productivity, Turbidity, Fluctuations, Water circulation, Density, Laurentian Channel.

Temperature, salinity and velocity profiles taken over a 5-day period in the St. Lawrence Estuary at the head of the Laurentian Channel are used to describe the semidiurnal tidal period isopycnal oscillations occurring in this region. The results show a regular occurrence of large vertical oscillations of the density field with semidiurnal periodicity. They also show the presence of a small amplitude quarter-diurnal variability and an important low frequency contribution which could not be analyzed because of the short record length. The observed variation in the degree of vertical mixing over the tidal cycle is used to support the concept of nutrification of the estuarine surface waters and suggests an explanation for the quarter-diurnal variability of primary production in this region. The influence of mixing processes occurring at the head of the Laurentian Channel act to modify the characteristics of the lower estuary surface waters by the vertical flux of subsurface waters near the sampling site. The findings suggest a semidiurnal infusion of nutrients into the euphotic zone and a quarter-diurnal variability in stability conditions, which may lead to a response in primary productivity as growth is much reduced/increased during periods of increased/decreased turbulence. (Moore-IVI)
W84-01387

WATER AND ORGANIC CARBON FLUXES FROM AN IRREGULARLY FLOODED BRACKISH MARSH ON THE UPPER TEXAS COAST, U.S.A.,
Rice Univ., Houston, TX. Dept. of Biology.
R. B. Borey, P. A. Harcombe, and F. M. Fisher.
Estuarine, Coastal and Shelf Science, Vol. 16, No. 4, p 379-402, April, 1983. 14 Fig, 3 Tab, 43 Ref. OCE 75-19633, DES 75-17184.

Descriptors: *Coastal marshes, *Organic carbon, Water level fluctuations, Flow rate, Flooding, Rainfall, Tidal floods, Seston, Vegetation, Sediment transport, Solute transport, Primary productivity, Detritus, Fluctuations, Brackish marshes, Texas.

Water flows, concentrations of total (TOC), dissolved (DOC), and particulate (POC) organic carbon and seston were monitored for 52 diel periods in the single creek draining a 270-ha Spartina patens - Distichlis spicata marsh on the upper Texas coast. Rainfall, creek water flows, and water levels in the creek and on the marsh were measured by recording instruments. Rainfall accounted for most marsh flooding, and water outflow was significantly correlated with both rainfall and marsh water level. Creek flows were predominantly outward because microtopographic features and dense vegetation restricted overmarsh water flows and thereby reduced tidal flooding while extending the time of precipitation runoff. Concentrations of organic carbon in water leaving the marsh were highest in spring and summer and averaged 25.62, 21.41 and 3.35 mg/l of TOC, DOC and POC, respectively. These were 9.34, 9.93 and 0.04 mg/l, respectively, higher than bay water. Most POC was 0.3-28 micro m in diameter. Seston > 28

microns leaving the marsh was 95% amorphous material; the rest was plankton, grass particles and fecal pellets. Loss of organic carbon was directly correlated with net water flux, and thus rainfall accounted for most carbon loss. Net carbon loss averaged 196 kg TOC, 150 kg DOC and 32 kg POC per day. Net annual loss was 2.4-5.5% of net aerial primary productivity (NAPP), or 21.55-30.09 g TOC/sq m/yr. Export from this marsh falls within the range found for other marshes and the data collectively indicate that coastal marshes are not losing as much organic carbon as has been suggested by indirect measurements. The discrepancy between potential and realized export is explained by the fact that export is not a simple removal of excess detritus by tidal action but is more complicated process mediated by the interaction of additional factors such as rainfall, vegetation structure, microtopographic variation and decomposition, which can serve to reduce the amount and quality of NAPP exported. (Author's abstract)
W84-01389

RIVER DISCHARGE CONTROLS PHYTOPLANKTON DYNAMICS IN THE NORTHERN SAN FRANCISCO BAY ESTUARY,
Geological Survey, Menlo Park, CA.
J. E. Cloern, A. E. Alpine, B. E. Cole, R. L. J. Wong, and J. F. Arthur.
Estuarine, Coastal and Shelf Science, Vol. 16, No. 4, p 415-429, April, 1983. 8 Fig, 2 Tab, 46 Ref.

Descriptors: *Estuarine environment, *Phytoplankton, *River flow, Drought, Flow discharge, Diatoms, Population dynamics, Mixing, Suspended sediments, Turbidity, San Francisco Bay.

Phytoplankton dynamics in the upper reach of the northern San Francisco Bay estuary are usually characterized by low biomass dominated by microflagellates or freshwater diatoms in winter, and high biomass dominated by neritic diatoms in summer. During two successive years of very low river discharge (the drought of 1976-1977), the summer diatom bloom was absent. This is consistent with the hypothesis that formation of the diatom population maximum is a consequence of the same physical mechanisms that create local maxima of suspended sediments in partially-mixed estuaries: density-selective retention of particles within an estuarine circulation cell. Because the estuary is turbid, calculated phytoplankton growth rates are small in the central deep channel but are relatively large in lateral shallow embaymcnts where light limitation is less severe. When river discharge falls within a critical range (100-350 cu m/s) that positions the suspended particulate maximum adjacent to the productive shallow bays, the population of neritic diatoms increases. However, during periods of high discharge (winter) or during periods of very low discharge (drought), the suspended particulate maximum is less well-defined and is uncoupled (positioned downstream or upstream) from the shallow bays of the upper estuary, and the population of neritic diatoms declines. Hence, the biomass and community composition of phytoplankton in this estuary are controlled by river discharge. (Author's abstract)
W84-01391

THE REMOVAL OF DISSOLVED HUMIC ACID DURING ESTUARINE MIXING,
Delaware Univ., Lewes. Coll. of Marine Studies.
L. E. Fox.
Estuarine, Coastal and Shelf Science, Vol. 16, No. 4, p 431-440, April, 1983. 5 Fig, 2 Tab, 29 Ref. OCE80-09835.

Descriptors: *Humic acids, *Estuaries, Mixing, Organic carbon, Solute transport, Salinity.

A simple method for the determination of dissolved humic acid based on carbon analysis is presented. This method was used to measure the distribution of dissolved humic acids in seven coastal plain estuaries located in the middle-Atlantic United States. Results indicate that 100% of the dissolved humic acid was removed during estuarine mixing, although concurrent measurements of dissolved organic carbon showed either production or conservative behavior in regions of the estuary where humic acid removal was observed. It is apparent from these observations that removal of dissolved humic acid is a minor part of the estuarine transport of dissolved organic carbon. Laboratory experiments carried out by mixing river water with sea water demonstrated that salt-induced removal of dissolved humic acid was insignificant in two of three estuaries studied. These results suggest in situ removal of dissolved humic acid may not be unive:sally caused by increasing estuarine salinity. (Author's abstract)
W84-01392

DISTRIBUTION OF SOME METALLIC ELEMENTS IN EELGRASS (ZOSTERA MARINA L.) AND SEDIMENT IN THE LIMFJORD, DENMARK,
Aarhus Univ. (Denmark). Botanical Inst.
H. Brix, and J. E. Lyngby.
Journal of Estuarine, Coastal and Shelf Science, Vol. 16, No. 4, p 455-467, April, 1983. 8 Fig, 3 Tab, 34 Ref.

Descriptors: *Submerged plants, *Sea grasses, *Metals, Sediments, Calcium, Cadmium, Copper, Iron, Potassium, Magnesium, Manganese, Sodium, Lead, Zinc, Mineral cycling, Brackish water, Limfjord, Denmark.

The distribution of Ca, Cd, Cu, Fe, K, Mg, Mn, Na, Pb and Zn in different parts of eelgrass (Zostera marina L.) and sediment (0-25 cm depth) collected at three locations in the Limfjord, Denmark, were investigated. Eelgrass plants were divided into roots, rhizomes, stems and leaves according to age, and the metal content in each fraction was determined. The distribution pattern of the metals could be divided into separate groups according to the following criteria: (i) the age-dependent distribution pattern of the metals in the leaves (the concentrations of Ca, Cd, Fe, Mg, Mn, Na, Pb and Zn increased with the age of the leaves; the concentrations of Cu and K decreased with age); (ii) the concentration level of the metals in the roots compared to that in the rhizomes (Ca, Cd, Cu, Fe, Mn, Pb and Zn concentrations were highest in the roots; K, Mg and Na concentrations were highest in rhizomes); (iii) the concentration level of the metals in the 'stem' -fraction compared to that in the youngest leaf (the concentration of Fe, K, Mg, Na and Pb were highest in the 'stem' -fraction; the concentrations of Ca, Cd, Mn and Zn were highest in the youngest leaf). The distribution pattern of the metals are discussed, especially in relation to the gross morphology of eelgrass. Finally, the relatively large quantity of metals tied up in the eelgrass biomass at the three localities indicated that the eelgrass beds most likely exerted a significant role in the metal cycling in the Limfjord. (Author's abstract)
W84-01393

ON THE PREDICTABILITY OF THE 137CS DISTRIBUTION IN THE SEVERN ESTUARY,
Washington Univ., Seattle. School of Oceanography.
M. Rattray, Jr., and R. J. Uncles.
Journal of Estuarine, Coastal and Shelf Science, Vol. 16, No. 5, p 475-487, May, 1983. 6 Fig, 3 Tab, 11 Ref.

Descriptors: *Estuaries, *Water circulation, Dispersion, Mathematical models, Salinity, Stratification, Runoff, Radioactive tracers, Cesium, Stokes drift, Severn Estuary.

The observed distribution of Cs137 resulting from known sources in the Severn Estuary permits the testing of simple predictive models for the one-dimensional distribution of non-conservative substances in an estuary. These models either use a known distribution of salinity to infer corresponding ones for other substances, or else directly solve mass balance equations utilizing previously determined dispersion coefficients. Both methods are shown to provide results comparing favorably with observations. Stokes drift plays an important role in the circulation of the Severn. A modified densimetric Froude number, including this drift, is therefore used to estimate the circulation and stratification of the estuary. A new equation is used for calculating the Cs137 distribution from the observed salinity distribution. It generalizes previous formulations to permit variation of the net runoff with position along the estuary. (Author's abstract)
W84-01394

THE TRANSPORT OF BACTERIA IN THE SEDIMENTS OF A TEMPERATE MARSH,
Smithsonian Institution, Edgewater, MD. Chesapeake Bay Center for Environmental Studies.
P. A. Rublee, S. M. Merkel, and M. A. Faust.
Journal of Estuarine, Coastal and Shelf Science, Vol. 16, No. 5, p 501-509, May, 1983. 4 Fig, 1 Tab, 17 Ref. DEB 7911563.

Descriptors: *Bacteria, *Salt marshes, Sediment transport, Estuaries, Interstitial water, Tidewater, Biomass, Particulates, Organic material, Marshes.

The number of bacteria in sediments, interstitial water and overlying tidal water of an oligohaline marsh system are about 109, 106 and 106 cells/cu cm, respectively. Average cell size in the overlying water (about 0.06 cu micro m), is much smaller than that in sediments and interstitial water (about 0.18 cu micro m). Most bacteria cells in sediments are bound to sediment particles and less than 1% of the cells were displaced by percolating water through sediment columns. Concentration of bacteria in flooding tidal waters is generally higher than that in ebbing waters. Movement of bacterial biomass does not appear to be a significant mechanism of particulate organic transport in marsh sediments and marsh sediments do not appear to be a source of suspended bacteria for estuaries. (Author's abstract)
W84-01395

3. WATER SUPPLY AUGMENTATION AND CONSERVATION

3A. Saline Water Conversion

EVALUATION OF THE HYDRODYNAMIC DISPERSION COEFFICIENT USING LEACHED FRACTION EQUATIONS,
Central Soil Salinity Research Inst., Karnal (India).
For primary bibliographic entry see Field 2G.
W84-01232

MATHEMATICAL MODEL FOR COMPOSITE MEMBRANES FOR REVERSE OSMOSIS,
National Taiwan Univ., Taipei. Dept. of Chemical Engineering.
C.-C. Lin, and M.-K. Chiang.
Separation Science and Technology, Vol. 18, No. 3, p 229-237, 1983. 6 Fig, 1 Tab, 9 Ref.

Descriptors: *Reverse osmosis, *Membrane processes, Desalination, Mathematical models, Simulation, Membranes, Permeability, Flow.

A mathematical model is developed to describe the transport phenomena in reverse osmosis desalination with composite membranes, which consist of two components having different value of A and B, where A is a membrane constant for water flow and B is a solute permeation constant. The composite membrane is composed of a dispersed phase (Component I) and a matrix phase (Component II). It is found possible to fabricate a high performance membrane by casting a film composed of a small particle size of Component II with a large value of A and a very thin Component I with a small value of B, in the practical separation technique. (Moore-IVI)
W84-01306

3B. Water Yield Improvement

USING HISTORICAL COMPARISONS IN EVALUATING CLOUD SEEDING OPERATIONS,

Rochester Univ., NY. Dept. of Statistics.
K. R. Gabriel, and D. Petrondas.
Journal of Climate and Applied Meteorology, Vol. 22, No. 4, p. 626-631, April, 1983. 8 Tab, 6 Ref.

Descriptors: *Cloud seeding, *Precipitation, Statistical methods, Simulation, Weather modification, History.

Cloud seeding operations are often evaluated by comparing precipitation during operations with records of previous 'historical' precipitation. Extensive worldwide precipitation records are used to examine whether the usual statistical techniques may be validly applied to comparisons of precipitation in successive years, as is done in the evaluations of cloud seeding. To study the operating characteristics of tests of significance, records of annual precipitation for successive years at a number of stations are divided into two periods, the first of which is regarded as 'historical' and the second as ' operational.' In this way, a pseudo-experiment can be simulated in which there is no effect of seeding. It is concluded that the chance of finding a significant seeding effect in the absence of seeding is usually well above the nominal significance level used. It is therefore recommend that P-values from such operational/historical comparisons be treated very cautiously, possibly by multiplying them by a suitable factor, e.g., a 5% significant result of such a comparison should really be regarded as more nearly as 10% significant. (Moore-IVI)
W84-01169

3C. Use Of Water Of Impaired Quality

CARBONATE DEPOSITS IN VACUUM PUMPS OF O'NEILL PUMPING PLANT, CALIFORNIA,
Water and Power Resources Service, Sacramento, CA.
N. P. Prokopovich, and E. G. Robles, Jr.
Bulletin of the Association of Engineering Geologists, Vol. 20, No. 2, p 197-203, May 1983. 9 Fig, 1 Tab, 3 Ref.

Descriptors: *Pumps, *Calcium carbonate, *Scaling, Cooling water, Carbon dioxide, Vacuum pumps, Reservoir operations, California.

The O'Neil Pumping-(Generating) Plant was designed to pump-lift mostly irrigational water from the Delta-Mendota Canal into O'Neil Forebay Reservoir. After a few months of operation pumping toe drain water to the pumping plant for use as cooling water, a small vacuum pump failed. Inspection of the dismantled pump revealed intense, buff-colored incrustations on its interior surface. The crust was strongly indurated with the steel body of the pump and was usually 0.5 mm thick, and locally 2-3 mm thick. Chemical tests of the scrapings indicate their composition to be of calcium carbonate with traces of limonitic pigment. Toe drain water is extremely rich in carbon dioxide and bicarbonate, and the concentration of both drops notably in the discharged cooling water. The original source of O'Neill water is the relatively soft, but highly turbid waters of the Sacramento-San Joaquin Delta. During storage in O'Neill and San Luis Reservoirs (both of which are underlain by calcareous deposits) the deltaic water dissolves variable amounts of soluble salts, particularly bicarbonates, and the decay of aquatic vegetation in the reservoirs creates carbon dioxide. This hard but clean water enters the vacuum pumps and, under vacuum conditions, releases its carbon dioxide, breaking soluble bicarbonates into carbon dioxide, water, and insoluble carbonate which is deposited on the pumps' interior surfaces. (Moore-IVI)
W84-01059

A CELL TO STUDY CORROSION OF MATERIALS IN THE WATER SUPPLY INDUSTRY,
Surrey Univ., Guildford (England). Dept. of Metallurgy and Materials Technology.
For primary bibliographic entry see Field 8G.
W84-01072

SALINE WATER USE PROSPECTS: COLORADO RIVER,
Bureau of Reclamation, Denver, CO. Colorado River Water Quality Office.
M. B. Bessler.
Journal of Irrigation and Drainage Engineering, Vol. 109, No. 2, p 221-231, June, 1983. 4 Fig, 4 Tab, 7 Ref.

Descriptors: *Saline water, *Alternative water use, Slurries, *Colorado River, River basin development, Water resources development, Economic aspects, Energy, Legal aspects.

Cost-effectiveness estimates are discussed for various alternative uses for saline water in the Colorado River Basin. Local saline water use, in areas less than 100 mi distant, for energy production looks promising, but cost-effectiveness is very sensitive to specific site conditions. In order to encourage use of saline water vs freshwater, most utilities need regulatory or financial incentives. The use of saline water for coal slurry transport appears to offer significant potential for joint use savings and reduction in the costs of salinity control. Legal issues and concerns raised about procedures for acquiring diversion rights, allocation of waste saline water among state and federal interests, and transfer of saline water across state boundaries are problems which must be addressed by the Basin states. The institutional arrangements for implementing the options lend themselves to a unique partnership between the federal government and industry. Through the federal salinity control effort, the use of desalting plants and lined evaporation ponds for ultimate disposal would require large monetary investments both in up front construction costs and in long term maintenance. If the private sector were to activate some of these alternative uses for saline water there would also be monetary investments needed. A part of the government capital, focused toward a joint venture with energy related industries, could mean decreased monetary investments for both government and industry and each would reap the rewards. A new bill to amend the 1974 Colorado River Salinity Control Act (Public Law 93-320) has been introduced recently which would permit such joint ventures to take place. (Baker-IVI)
W84-01152

RE-CYCLING OF INDUSTRIAL COOLING WATER,
G. B. Hill.
Water and Waste Treatment Journal, Vol. 26, No. 5, p 56-57, May, 1983. 2 Fig.

Descriptors: *Water cooling, *Water reuse, Recirculated water, Design criteria, Cooling ponds, Cooling towers, Refrigeration.

In the light of the growing costs and restrictions imposed upon industrial usage of mains water, together with the vulnerabilities exposed by supply failures, there are increasing requests for recirculatory cooling water systems. The simplest method for cooling water is the cooling pond. A spray pond extends the principle a little further, but both methods suffer from water contamination and are only suitable for cooling water received at higher temperatures. Another simple method is the atmospheric cooling frame where water is sprayed down a louvered shell through which the wind blows, mixing with the water and cooling it. Performance is dependent on weather and the system suffers from water carry-over. Chimney natural draft cooling towers have warm water released at the top of the tower falling over the large area of packing below, while air flowing up through the tower by convection cools the water. Mechanical draft cooling towers are almost independent of atmospheric conditions, other than the ambient wet bulb temperature. Air blast coolers pass heated water through tubes over which cooling air is blown by an axial flow fan. Heat transfer is assisted by fitting fins or wire on the tube outer surface. Water chillers employ the basic mechanical compression refrigeration systems of reciprocating, centrifugal or screw design. Adsorption systems are rarely used. The water cooling duty related to the water flow rate and temperature rise when passing through the plant, determines the type and size of equipment needed. (Baker-III)
W84-01259

ECONOMICS OF IRRIGATION WATER MIXING WITHIN A FARM FRAMEWORK,
California Univ., Riverside. Dept. of Soil and Environmental Sciences.
E. Feinerman, and D. Yaron.
Water Resources Research, Vol. 19, No. 2, p 337-345, April, 1983. 6 Tab, 19 Ref.

Descriptors: *Saline water, *Irrigation water, Mathematical models, Decision making, Economic aspects, Salinity, Crop selection, Rainfall, Saline soils, Israel.

Linear programming models, deterministic in the short run and stochastic (random rainfall) in the long run, aimed at guiding annual decision making with regard to crop mix and saline irrigation water mixing from various sources within a farm framework, are presented. The short-run model incorporates the physical, biological, and economic relationships involved in one endogenous system and enables an in-depth analysis of them but is limited to a single year. The long-run model considers the effects of the short-run decisions on the future but several relationships are incorporated exogenously. The short-run model's results are utilized for the determination of some of these predetermined relationships. The models are applied to a potential farm situation in southern Israel. The results provide priorities in the allocation of water and soil plots of varying salinity levels and empirical estimates of the shadow prices and the rates of substitution between the limited resources. (Author's abstract)
W84-01360

3D. Conservation In Domestic and Municipal Use

REGIONAL VERSUS LOCAL WATER SUPPLY PLANNING,
Corps of Engineers, Baltimore, MD. Baltimore District.
For primary bibliographic entry see Field 6B.
W84-01141

WELLESLEY'S WATER PROGRAM PLANNING; DEMAND STRATEGY,
Massachusetts Dept. of Public Works, Wellesley Hills.
For primary bibliographic entry see Field 6D.
W84-01156

3F. Conservation In Agriculture

WATER ALLOCATION CONFLICTS ON THE CANADIAN PRAIRIES,
Manitoba Univ., Winnipeg. Dept. of Civil Engineering.
For primary bibliographic entry see Field 6D.
W84-01145

INTERRELATIONSHIPS OF IRRIGATION UNIFORMITY TERMS,
Arizona Univ., Tucson. Dept. of Soils, Water and Engineering.
A. W. Warrick.
Journal of Irrigation and Drainage Engineering, Vol. 109, No. 3, p 317-332, September, 1983. 3 Fig, 2 Tab, 20 Ref.

Descriptors: *Irrigation efficiency, *Infiltration, *Uniformity coefficient, Soil water, Variability, Surface irrigation, Level basin irrigation, Statistical methods.

Irrigation uniformities are examined for six assumed statistical distributions of depth of water infiltrated. Christiansen's uniformity (UC) and the lower quarter distribution uniformity (DU) are related analytially to the coefficient of variability (CV) in each case. The distributions chosen are the

normal, log normal, uniform, a specialized power, beta and gamma distributions. In all cases studied, for CV values of less than 25%, approximate forms of UC and DU were found valid. Three examples are given using the specialized power and beta distribution. It is demonstrated that the specialized power function is exact for level basin irrigation provided the surface water advance is proportional to a power of time and the intake rate everywhere has approached a constant value before recession. (Author's abstract)
W84-01147

DROUGHT ANALYSIS AND SOIL MOISTURE PREDICTION,
Eidgenoessische Technische Hochschule, Zurich (Switzerland). Versuchsanstalt fuer Wasserbau, Hydrologie und Glaziologie.
G. M. Smart.
Journal of Irrigation and Drainage Engineering, Vol. 109, No. 2, p 251-261, June, 1983. 6 Fig, 1 Tab, 14 Ref.

Descriptors: *Soil water, *Drought, *Irrigation requirements, Mathematical models, Rainfall, Evaporation, Pastures, Water demand, New Zealand, South Island, Canterbury Plain.

On the alluvial Canterbury Plain in the South Island of New Zealand, short-term variation in rainfall is considerable. On most irrigated farms, irrigation is determined by a roster allocation system or a demand system. Both roster and demand systems require a technique for estimating the current soil moisture status if they are to be efficient in terms of water usage. Soil moisture levels are predicted by a simple, conceptual accounting model run with daily rainfall and evaporation inputs. Model output is used to illustrate practical statistical procedures for drought frequency, duration and severity. Frequency is defined by the probability of a drought starting in a given month, duration is determined by run-length analysis and severity is given in terms of soil moisture level. Predicted moisture contents for the top 100 mm (4 in.) of soil below ryegrass pasture are statistically similar to actual moisture levels measured in Canterbury, New Zealand. For this location. accurate rainfall forecasts could substantially reduce irrigation water demands. (Moore-IVI)
W84-01149

OPTIMUM MOISTURE CONTENT FOR COMPACTING SOILS: ONE-POINT METHOD,
Irrigation Research Inst., Lahore (Pakistan).
For primary bibliographic entry see Field 2G.
W84-01151

HEAD LOSS AT SOIL-DRAIN ENVELOPE INTERFACES,
North Carolina State Univ. at Raleigh. Dept. of Biological and Agricultural Engineering.
For primary bibliographic entry see Field 4A.
W84-01153

AMOUNT OF PROFILE WATER IN EARLY SPRING RESULTING FROM INCREASED PROFILE WATER IN FALL,
Kansas Agricultural Experiment Station, Manhattan. Evapotranspiration Lab.
L. R. Stone, C. G. Carlson, T. L. Hanson, R. E. Gwin, Jr., and P. Gallagher.
Soil Science Society of America Journal, Vol. 47, No. 2, p 305-309, March-April, 1983. 4 Fig, 1 Tab, 13 Ref.

Descriptors: *Irrigation efficiency, *Fall irrigation, Soil water, Field capacity, Corn, Alfalfa, Wheat, Water storage, Profile water.

Cost and availability of fuel, water supplies, and labor are creating interest in extending irrigation into the dormant season. The amount of profile water in early spring that resulted from increased profile water in fall was assessed at three locations where soil, climate, and limited irrigation resources suggest fall irrigation has potential as a management practice. Soils were Ulysses silt loam (fine-silty, mixed, mesic Aridic Haplustoll), Amsterdam silty clay loam (fine-silty, mixed Typic Cryoboroll), and Great Bend silt loam (fine-silty, mixed Udic Haploboroll) at Tribune, Kansas, Bozeman, Montana, and Redfield, South Dakota, respectively. Crops were corn and winter wheat at Tribune; alfalfa and spring wheat at Bozeman; and alfalfa, corn, spring wheat, and winter wheat at Redfield. Differences in crop growth patterns and irrigation regimes provided a broad range of fall soil water contents at each location. Profile soil water content was sampled gravimetrically at Tribune and by neutron attenuation at Bozeman and Redfield no earlier than 10 d after fall irrigation and in early spring. By multiple regression analysis, it was established that profile water content change rate during winter (profile water at early-spring sampling minus profile water at fall sampling divided by the number of days) decreased and as available soil water in fall increased. The amounts of profile water in early spring resulting from 10 mm of additional fall profile water, calculated by using the long-term precipitation mean for 22 December through 31 March at each location (0.44, 0.54, and 0.52 mm/d for Tribune, Bozeman, and Redfield, respectively) were: 8.6, 6.8, and 5.0 mm at Tribune; 8.5, 7.5, and 6.6 mm at Bozeman; and 8.2, 7.0, and 5.8 mm at Redfield for available soil water values in fall of 30, 50, and 70%, respectively. The data and calculations show fall irrigation to be an inefficient practice for many situations, even where the antecedent profile water content is well below the 'field capacity' value. (Moore-IVI)
W84-01163

STATISTICAL ANALYSIS OF LINE-SOURCE SPRINKLER EXPERIMENTS AND OTHER NONRANDOMIZED EXPERIMENTS USING MULTIVARIATE METHODS,
Kansas State Univ., Manhattan. Dept. of Statistics.
D. E. Johnson, U. N. Chaudhuri, and E. T. Kanemasu.
Soil Science Society of America Journal, Vol. 47, No. 2, p 309-312, March-April, 1983. 1 Fig, 3 Tab, 4 Ref.

Descriptors: *Statistical analysis, *Sprinkler irrigation, Crop yield, Multivariate analysis, Mathematical studies.

The line-source sprinkler system provides a continuous variable soil water gradient away from a water source. The system can be used effectively to study the effects of various levels of water applied on crops, and minimizes the amount of land required for such experiments. A recent paper suggested that there was no statistical test available for comparing the effects of irrigation level on yield because irrigation levels are often applied systematically without randomization. This paper shows how multivariate methods can be used to obtain an appropriate statistical test. The method can also be used for many other nonrandomized experiments. One such experiment occurs when readings on the same experimental unit are recorded at several different time periods. Another occurs when measurements are made on several different parts of the same plant, e.g. stem, leaf, etc. The methods provide tests for equal cultivar effects; irrigation effects, and also cultivar X irrigation level interaction. (Moore-IVI)
W84-01187

HEAT REJECTION SYSTEMS: MEETING COSTS, DEMANDS AND REGULATORY REQUIREMENTS,
R. C. Rittenhouse.
Power Engineering, Vol. 87, No. 6, p 46-54, June, 1983. 6 Fig, 4 Tab.

Descriptors: *Cooling towers, *Water cooling, Cooling ponds, Powerplants, Water reuse, Wastewater treatment, Chlorination, Water management.

The heat rejection system in a power plant can offer cost savings if care is exercised in design, operation and maintenance, and if the developing need to upgrade is met with a timely response. Cooling towers may be needed for powerplants in the future because of: tightening regulations for once-through cooling; real estate and water shortages; environmental impact, and the large amounts of cooling surface which may be needed. Use of a cooling tower vs cooling lakes is considered. The potential advantages of multiple use of cooling lakes should be considered during the evaluation of types of cooling systems to be chosen for a site. Maintenance and upgrading of tower operations are important for controlling costs. Environmental regulations limiting the concentration of chlorine discharges make it imperative that utility staff people monitor the behavior of the biocide to optimize its capabilities while controlling its discharge. Water conservation or the lack of water in arid regions are the primary reasons for the development of wet/dry and dry cooling tower technology. (Baker-IVI)
W84-01236

4. WATER QUANTITY MANAGEMENT AND CONTROL

4A. Control Of Water On The Surface

FLOOD ROUTING ON A SMALL COMPUTER,
New Mexico Univ., Albuquerque. Dept. of Civil Engineering.
For primary bibliographic entry see Field 7C.
W84-01089

CONSERVATISM OF PROBABLE MAXIMUM FLOOD ESTIMATES,
Harza Engineering Co., Chicago, IL.
For primary bibliographic entry see Field 8B.
W84-01097

ESTIMATING UNIT HYDROGRAPH PEAK RATE FACTORS,
Maryland Univ., College Park. Dept. of Civil Engineering.
For primary bibliographic entry see Field 2E.
W84-01150

HEAD LOSS AT SOIL-DRAIN ENVELOPE INTERFACES,
North Carolina State Univ. at Raleigh. Dept. of Biological and Agricultural Engineering.
D. W. Miller, and L. S. Willardson.
Journal of Irrigation and Drainage Engineering, Vol. 109, No. 2, p 221-220, June, 1983. 4 Fig, 3 Tab, 9 Ref.

Descriptors: *Head loss, *Hydraulic gradient, Hydraulic permeability, Drainage practices, Permeability, Interfaces, Laminar flow, Fluid mechanics, Earth-water interfaces, Soil physical properties.

A two-stage upward flow permeameter was designed which allowed a screen or filter fabric disk to be inserted in the center of a soil column as well as at the outlet of the permeameter. The interface was studied under two conditions: one with water passing from a porous medium through an interface and back into the same medium, and a second with water passing from a porous medium through an interface and into water ponded above the interface. A fundamental difference was found between the head loss across the two interfaces. The difference in hydraulic gradients at internal and exit interfaces was attributed to the simultaneous action of two processes: the physical restructuring of the interfacial zone as viscous drag caused soil particles or sand grains to bridge over or plug pores in the interface; and a second process, which seems to be a function of the changing ratio of viscous and inertial forces occurring as water passes through exit interfaces. The geometry of the flow paths changes dramatically during this passage and this change in turn alters the distribution of viscous shear and inertial forces acting between the water and the boundaries of individual flow paths. Head loss in soil was greater at exit interfaces than would be predicted using laminar flow theory. Water leaving the soil and entering a drain

or a very permeable drain envelope demonstrates an excess energy loss. Artificial internal interfaces in the soil do not show the same head loss as exit interfaces. Inertial energy losses seem to explain the difference in the head losses measured for the two types of interfaces. The findings suggest that high gradients at exit interface of a porous medium mean that hydraulic failure gradients may occur under flow conditions that would theoretically be stable. The effect of the large exit gradient could also reduce the apparent permeability of soil samples where only inflow and outflow heads are measured. Piezometers measuring internal hydraulic gradients in soil samples should be at least 4 cm away from the exit interface. (Baker-IVI)
W84-01153

4B. Groundwater Management

ISOTOPIC INVESTIGATION OF A NEAR-SURFACE GROUNDWATER SYSTEM,
Heidelberg Univ. (Germany, F.R.). Inst. fuer Umweltphysik.
For primary bibliographic entry see Field 2G.
W84-01102

HP41C AND T159 PROGRAMS FOR ANISOTROPIC CONFINED AQUIFERS,
Kansas Univ., Lawrence.
For primary bibliographic entry see Field 2F.
W84-01115

GROUND-WATER MODELING WITH AN INTERACTIVE COMPUTER,
Idaho Univ., Moscow. Dept. of Agricultural Engineering.
For primary bibliographic entry see Field 2F.
W84-01116

NOORDBERGUM EFFECT AND CHARACTERIZATION OF AQUITARDS AT THE RIO MAIOR MINING PROJECT,
Laboratorio Nacional de Engenharia Civil, Lisbon (Portugal).
For primary bibliographic entry see Field 2F.
W84-01117

HYDROGEOLOGY OF PIPELINE CANYON, NEAR GALLUP, NEW MEXICO,
New Mexico Health and Environment Dept., Santa Fe. Environmental Improvement Div.
For primary bibliographic entry see Field 2F.
W84-01118

DETERMINING HYDRAULIC CONDUCTIVITY DISTRIBUTIONS IN A MOUNTAINOUS AREA USING MATHEMATICAL MODELING,
Campbell Geoscience Ltd., Calgary (Alberta).
For primary bibliographic entry see Field 2F.
W84-01119

SALT-WATER INTRUSION IN THE NILE DELTA,
A.-A. I. Kashef.
Ground Water, Vol. 21, No. 2, p 160-167, March-April, 1983. 4 Fig.

Descriptors: *Saline water intrusion, *Groundwater management, *Groundwater potential, Egypt, Nile River, Groundwater recharge, Irrigation water, Groundwater irrigation, Geohydrology, Land reclamation, Infiltration, Seepage.

Egypt is presently involved in a comprehensive program of land reclamation. Surface water has already been exhausted in meeting the urgent needs of agricultural expansion. Ground-water development has priority over increasing irrigation efficiency (which would take a longer time). A review of the recent investigations of the groundwater resources in the Delta aquifer is given, and an attempt is made to determine the extent of intrusion using two unconventional methods based on the available geohydrological data. The case is unique because most of this aquifer is invaded by salt water, and the major portion of its annual ground-water recharge is derived from the direct seepage from the Nile River and the huge net of irrigation canals serving about 3 million acres (approximately 11,561 sq km) of fertile land, as well as the infiltration of excess irrigation water. The annual overall groundwater recharge to the aquifer was estimated as 6.40 cu km/yr. Methods of salt-water control and various techniques of water resources management are discussed. Groundwater development may be started south of potentiometric contour +10 and along the Nile branches (if there is no conflict in water use). North of contour +10, utmost care should be observed regarding high pumping or extensive developments. It is recommended that pilot projects be started to control salt-water intrusion. (Moore-IVI)
W84-01120

HARMONIZING GHYBEN-HERZBERG INTERFACE WITH RIGOROUS SOLUTIONS,
A.-A. I. Kashef.
Ground Water, Vol. 21, No. 2, p 153-159, March-April, 1983. 1 Fig, 2 Tab, 8 Ref.

Descriptors: *Saline-freshwater interfaces, *Saline water intrusion, Mathematical studies, Groundwater management, Coastal aquifers, *Ghyben-Herzberg interface, Groundwater movement.

Ground-water management in coastal aquifers is becoming highly complex due to the increase in water demand coupled with the threat of salt-water encroachment. The salt-water/fresh-water interface produced by the natural flow of the aquifer is distorted as a result of ground-water exploitation. During the last four decades, the use of Ghyben-Herzberg (G-H) principle to determine the salt-water/fresh-water interface in coastal aquifers was questioned by many investigators due to the neglect of the water movement. Some of the highly complex solutions which were later introduced are reviewed and compared with the G-H results for a very wide range of parameters. It has been found that the G-H principle is valid for practical purposes and that the differences between location of the interface predicted by the G-H principle and those determined by the rigorous solutions may be less than the differences resulting from small errors in the field records of water levels. For exceptionally high natural velocities and for more precision within the zones very close to the shore, two simple equations derived on the basis of the rigorous solutions are given. Each equation is written in terms of the popular G-H solution with a correction factor added. The results of these equations are tabulated in dimensionless values for practical use. Moreover, the extent and size of the fresh-water lens can be determined from the field records of one or two shallow observation wells. An example is given to clarify the procedure. (Moore-IVI)
W84-01121

BASIN RECHARGE OF PLAYA WATER,
Agricultural Research Service, Bushland, TX. Conservation and Production Lab.
A. D. Schneider, and O. R. Jones.
Journal of Irrigation and Drainage Engineering, Vol. 109, No. 3, p 309-316, September, 1983. 4 Fig, 1 Tab, 8 Ref.

Descriptors: *Recharge basins, *Artificial recharge, *Ogallala aquifer, *Playas, Storm runoff, Groundwater recharge, Permeability, Turbidity, *Texas, High Plains.

A 0.20-ha (0.5-acre) recharge basin was tested for conserving storm runoff that collected in a 16-ha (40-acre) playa in the Southern High Plains, southwest of Amarillo, Texas. The basin was constructed by removing 1.2 m (4 ft) of the slowly permeable Pullman soil to expose a 0.3 (1-ft) thick caliche layer overlying permeable sediments. Turbid water was pumped from the playa to the basin during eight tests over a 7-yr interval. Average recharge rate during 187 days of flooding was 0.373 m/d (1.22 ft/day). After three recharge tests during the first year, no maintenance was done to the basin bottom. Research showed that recharge basins could be an effective technique for partially replenishing the depleted Ogallala Aquifer. (Moore-IVI)
W84-01148

THE DECLINE AND PARTIAL RECOVERY OF GROUNDWATER LEVELS BELOW LONDON,
Institute of Hydrology, Wallingford (England).
T. J. Marsh, and P. A. Davies.
Proceedings of the Institution of Civil Engineering, Vol. 74, p 263-276, May, 1983. 14 Fig, 12 Ref.

Descriptors: *Groundwater levels, *Groundwater recession, England, Confined aquifers, Saline water intrusion, Boreholes, Groundwater depletion, Subsidence, Groundwater management, Economic aspects, Licensing.

Until recently groundwater levels in the Chalk and Lower London Tertiary deposits below London (England) have been declining in response to heavy exploitation of the groundwater resource. By 1950, groundwater levels stood 20 m below OD throughout most of the confined aquifer. The depletion in groundwater resources had consequences extending beyond the water supply industry, including the failure of supply boreholes, salt water intrusion, ground settlement, a reduction in river flows, and an increasing frequency of failure of springs. The growing appreciation of these problems by water management together with the economic decline following the 1939-1945 war and borehole licensing provisions brought a virtual stop to further aquifer development. Total groundwater abstraction from the confined aquifer reached a peak of 80,000,000 cu m/ a between 1925 and 1940; yield had fallen back to 62,000,000 cu m/ a by 1965. During the past 20 years, a modest recovery in groundwater levels has taken place, but the recovery should be regarded as fragile. (Moore-IVI)
W84-01249

A REVIEW OF DISTRIBUTED PARAMETER GROUNDWATER MANAGEMENT MODELING METHODS,
Geological Survey, Menlo Park, CA.
S. M. Gorelick.
Water Resources Research, Vol. 19, No. 2, p 305-319, April, 1983. 1 Fig, 102 Ref.

Descriptors: *Groundwater management, *Management models, Model studies, Groundwater movement, Solute transport, Water allocation, Policy making, Water quality, Underground waste disposal, Water quality management, Groundwater hydraulics, Economic aspects, Political aspects.

Models which solve the governing groundwater flow or solute transport equations in conjunction with optimization techniques, such as linear and quadratic programming, are powerful aquifer management tools. Groundwater management models fall in two general categories: hydraulics or policy evaluation and water allocation. Groundwater hydraulic management models enable the determination of optimal locations and pumping rates of numerous wells under a variety of restrictions placed upon local drawdown, hydraulic gradients, and water production targets. Groundwater policy evaluation and allocation models can be used to study the influence upon regional groundwater use of institutional policies such as taxes and quotas. Furthermore, fairly complex groundwater-surface water allocation problems can be handled using system decomposition and multilevel optimization. Experience from the few real world applications of groundwater optimization-management techniques is summarized. Classified separately are methods for groundwater quality management aimed at optimal waste disposal in the subsurface. This classification is composed of steady state and transient management models that determine disposal patterns in such a way that water quality is protected at supply locations. Classes of research missing from the literature are groundwater quality management models involving nonlinear constraints, models which join groundwater hydraulic and quality simulations with political-economic management considerations, and management models that include parameter uncertainty. (Author's abstract)
W84-01359

4C. Effects On Water Of Man's Non-Water Activities

PROXY VARIABLES FROM POLLUTION CONTROL,
Iowa State Univ., Ames. Center for Agricultural and Rural Development.
D. R. Daines, Jr., and E. O. Heady.
Journal of Environmental Quality, Vol. 12, No. 2, p 203-208, April-June, 1983. 7 Tab, 8 Ref.

Descriptors: *Water pollution control, *Nonpoint pollution sources, *Soil management, *Farms, Soil erosion, Public policy, Taxes, Economic aspects, Legal aspects.

Where the level of pollution from one farm cannot be reliably measured or estimated, environmental policies may be difficult to formulate and enforce. For this situation, a policy approach is suggested, which focuses on variables other than direct output of pollution. The use of proxy variables is illustrated in an analysis of alternative policies for controlling agricultural soil loss in the United States. An interregional programming model of U.S. agriculture is used to analyze and compare the proxy variable approach to direct limits and taxes on gross soil loss, with soil management practices employed as proxy variables. In achieving targeted soil loss reductions, the soil management practice policy would be less costly to society than a direct limit of 12.5 t/ha of soil loss, but a tax on each t of soil loss would be the least costly approach, assuming that soil loss could be easily quantified. (Author's abstract)
W84-01198

LAND USE, FLOODS, AND CHANNEL CHANGES: UPPER MIDDLE FORK WILLAMETTE RIVER, OREGON (1936-1980),
Oregon State Univ., Corvallis. School of Forestry.
J. K. Lyons, and R. L. Beschta.
Water Resources Research, Vol. 19, No. 2, p 463-471, April, 1983. 5 Fig, 2 Tab, 28 Ref.

Descriptors: *Land use, *Flood damage, *Channel morphology, Landslides, Peak flows, Precipitation, Logging, Road construction, Clear-cutting, Mathematical models, Forest watersheds, Willamette River, Oregon.

Flow trends and channel characteristics from 1936 to 1980 were evaluated for the Middle Fork Willamette River, which drains a 668-sq km forested watershed in the Cascade Mountains of western Oregon. An inventory of aerial photographs from 1959 to 1972 shows that landslides associated with roads and in clearcuts were 27 and 23 times more frequent, respectively, than in forested areas. Numerous landslides unloaded sediments directly into the drainage system; most landslides appear to have been initiated during a large flood (return period greater than or equal to 100 years) of December 22, 1964. Analysis of precipitation and peak flows (greater than 100 sq m/s) from 1958 to 1980 by means of power function models suggests a trend of increasing flows as timber harvesting and road building expanded in the basin. Changes in channel pattern, documented from aerial photographs, show major increases in channel width from 1959 to 1967 and a trend of decreasing width from 1967 to 1980. During summer low flows in 1979 and 1980, 65 cross sections of the channel were surveyed to provide detailed measurements of existing channel conditions. Channel widths of 62% of the aggraded reaches were significantly greater (alpha=0.05) than those for nonaggraded reaches. (Author's abstract)
W84-01346

4D. Watershed Protection

THE ENVIRONMENTAL MONITORING PROGRAM FOR THE WATERSHED OF THE GREAT POND AND RICHARDI RESERVOIRS,
Stone and Webster Engineering Corp., Boston, MA.

For primary bibliographic entry see Field 6B.
W84-01158

5. WATER QUALITY MANAGEMENT AND PROTECTION

5A. Identification Of Pollutants

STUDIES ON THE ANODIC STRIPPING VOLTAMMETRY OF LEAD IN POLLUTED ESTUARINE WATERS,
Pontificia Univ. Catolica do Rio de Janeiro (Brazil). Dept. de Quimica.
S. A. Acebal, and A. D. Rebello.
Analytica Chimica Acta, Vol. 148, p 71-78, April 1983. 5 Fig, 2 Tab, 14 Ref.

Descriptors: *Lead, *Seawater, *Copper, *Voltammetry, Estuarine environment, *Pollutant identification, *Brazil, Guanabara Bay.

Lead was determined in the polluted tropical waters of Guanabara Bay (Rio de Janeiro, Brazil) by anodic stripping voltammetry in the differential pulse and linear sweep modes. The quantitative implications of heavy metal determinations in polluted sea water and some electrochemical parameters concerning the two voltammetric modes are discussed, as well as the efficiency of the hanging mercury drop mercury film electrodes. Values found for total lead concentration range between 0.07 and 5.4 microgram/kg. Some data are also presented for copper which was shown to interfere at pH greater than 2. (Wheatley-IVI)
W84-01060

INTERLABORATORY STUDY ON DETERMINATION OF 2,3,7,8-TETRACHLORODIBENZO-P-DIOXIN IN FISH,
Health and Welfare Canada, Ottawa (Ontario). Health Protection Branch.
J. J. Ryan, J. C. Pilon, H. B. S. Conacher, and D. Firestone.
Journal of the Association of Official Analytical Chemists, Vol. 66, No. 3, p 700-707, May, 1983. 7 Tab, 12 Ref.

Descriptors: *Dioxins, *Chemical analysis, *Fish, Great Lakes, Water pollution effects, Tetrachlorodibenzo-p-dioxin, Chlorinated hydrocarbons.

An interlaboratory round robin study was carried out to estimate the reliability of data on 2,3,7,8-tetrachlorodibenzo-p-dioxin (TCDD) in fish. Using different methods, 13 laboratories (4 Canadian, 9 American) agreed to analyze 4 fish samples; 3 were Great Lakes salmonids containing bio-incurred levels of TCDD below 100 ppt and the fourth was an ocean fish fillet containing no measurable TCDD. Samples were sent as freeze-dried portions as it was shown that no change of TCDD occurred by this sample preparation. Results were normalized between laboratories by supplying each with an aliquot of the same 2,3,7,8-TCDD standard. Eight laboratories reported a set of results of which one set was rejected. Values from the 7 remaining laboratories for the 3 positive fish showed mean concentrations in pg/g (ppt) and (CV,%) of 61.2 (13.9), 30.4 (18.4) and 32.3 (25.4). Detection limits averaged 3.6 ppt and ranged between 1 and 10 ppt. No significant differences appeared in the concentration of 2,3,7,8-TCDD in fish samples from methods differing in the use of: (i) digestion or extraction techniques, (ii) high or low resolution mass spectrometry, and (iii) isomer specific or nonspecific separations. Overall recovery values using internal standards varied greatly (29-109%) even within the same laboratory and pointed to the need to use an internal standard to obtain precise results. Agreement among laboratories was good considering the level quantitated (ppt) and the diverse methodology. (Author's abstract)
W84-01062

EXTRACTION AND CLEANUP PROCEDURES FOR DETERMINATION OF DIARYLPHOSPHATES IN FISH, SEDIMENT, AND WATER SAMPLES,
Department of Fisheries and Oceans, Winnipeg (Manitoba). Freshwater Inst.
D. C. G. Muir, and N. P. Grift.
Journal of the Association of Official Analytical Chemists, Vol. 66, No. 3, p 684-690, May, 1983. 3 Fig, 6 Tab, 12 Ref.

Descriptors: *Diarylphosphates, *Gas liquid chromatography, *Chemical analysis, Fish, Water pollution, Sediments, Phosphates, *Pollutant identification.

Methods for determination of triaryl/alkylphosphates (TAPs) in water, fish, and sediment were extended to determination of the diarylphosphate (DAP) degradation products. DAPs were extracted from water (adjusted to pH 0.5) by use of XAD-2 resin and determined by gas-liquid chromatography (GLC) as butyl esters. Recoveries of diphenylphosphate (DPP) and o-, m-, p-dicresylphosphates (DoCP, DmCP, DpCP) were > 95% in water samples fortified at 1, 10, and 50 microgram/L. DAPs were extracted from fish with methanol and the extracts were cleaned up on reverse phase (C18) silica cartridges. Recoveries were > 87% for DPP, DoCP, DmCP, and DpCP in fish muscle fortified at 50, 100, and 500 ng/g. Sediments were refluxed with aqueous methanol and DAPs were recovered by use of XAD-2 resin. Recoveries of DAPs from sediments fortified at 50 and 100 ng/g were >76%. Interferences (1-10 ng/g) from phosphorous or nitrogen-containing GLC prevented sub-ng/g level analysis for DAPs in sediment and fish extracts. (Author's abstract)
W84-01063

HIGH RESOLUTION GAS CHROMATOGRAPHY OF CHLORINATED BENZENES,
Food and Drug Administration, Washington, DC. Div. of Chemical Technology.
L. J. Miller, T. J. Farrell, and B. J. Puma.
Journal of the Association of Official Analytical Chemists, Vol. 66, No. 3, p 677-683, May, 1983. 4 Fig, 2 Tab, 14 Ref.

Descriptors: *Benzenes, *Chlorinated hydrocarbons, *Gas chromatography, Water pollution, Chemical analysis, Chlorinated benzenes, *Pollutant identification.

Chlorinated benzenes are found as contaminants in foods and water. These high production volume chemicals may enter the environment and food chain through improper waste disposal, use as solvents and odor control agents, or as impurities in other industrial chemicals. Because of differences in the electron capture responses of the isomers at each chlorination level, residue quantitation requires the separation of all 12 chlorobenzenes. Resolution was studied on packed and capillary columns coated with Kovats' C-87 H-176 hydrocarbon, OV-101, OV-210, OV-17, and Carbowax 20M. Satisfactory resolution of all 12 chlorobenzenes was obtained with a Carbowax 20M-coated 20 m x 0.25 mm id capillary column operated isothermally at 120 degrees C. (Author's abstract)
W84-01064

GAS-LIQUID CHROMATOGRAPHIC DETERMINATION OF S,S,S,-TRIBUTYL PHOSPHOROTRITHIOATE (DEF) IN WATER AND FISH TISSUE,
Columbia National Fisheries Research Lab., MO.
R. G. Lehmann, L. M. Smith, R. H. Wiedmeyer, and J. D. Petty.
Journal of the Association of Official Analytical Chemists, Vol. 66, No. 3, p 673-676, May 1983. 2 Fig, 2 Tab, 9 Ref.

Descriptors: *Defoliants, *Chemical analysis, *Gas chromatography, Fish, Agricultural chemicals, Water pollution, *Pollutant identification.

The widespread use of the cotton defoliant S,S,S-tributylphosphorotrithioate (DEF) suggests the possibility for contamination of freshwater fisheries from runoff and possibly from aerial transport. Methods are described for determination of DEF at levels as low as 5 parts per billion in fish and 200

parts per trillion in water. Fish tissue extracts are subjected to gel permeation chromatography (GPC) and silica gel chromatography; water samples are extracted with dichloromethane. Analyses are carried out by gas chromatography in which either electron capture or thermionic specific detectors are used. The applicability of the methods is demonstrated by analyses of water and fish samples from exposure studies. (Moore-IVI)
W84-01066

LIQUID CHROMATOGRAPHIC DETERMINATION OF GLYPHOSATE IN FORTIFIED SOIL AND WATER SAMPLES,
Agricultural Research Service, Beltsville, MD. Weed Science Laboratory.
R. L. Glass.
Journal of Agricultural & Food Chemistry, Vol. 31, No. 2, p 280-282, March-April, 1983. 2 Fig, 2 Tab.

Descriptors: *Glyphosate, *Chemical analysis, Herbicides, Chromatography, Soil analysis, Pesticide residues, *Pollutant identification.

A high-performance liquid chromatographic (HPLC) method which used fluorescence detection and an amine phase column is described for the determination of glyphosate in fortified soil and water samples after the derivatization of the herbicide. Glyphosate was extracted and subsequently separated with Bio-Rad AG 1-X8 anion-exchange resin (HC03(-)form) prior to derivatizing with the fluorogenic labeling reagent, 9-fluorenylmethyl chloroformate (FMOCCI). The rate of conversion of glyphosate to the glyphosate-FMOCCL derivative was about 60%. The minimum levels of detection for glyphosate were 10 ppb in fortified water, 5 ppm in a sandy loam soil, and 50 ppm in a clay loam soil. Recoveries of glyphosate were greater than 90% in water fortified at 20 ppb-4 ppm, 55% in the sandy loam soil, and about 20% in the clay loam soil fortified at 200 ppm. In comparison to other reported methods this HPLC method is simpler, faster, and specific for glyphosate. (Author's abstract)
W84-01079

LESSONS FROM THE SILICA 'DECLINE' IN LAKE MICHIGAN,
Minnesota Univ., Minneapolis. Limnological Research Center.
J. Shapiro, and E. B. Swain.
Science, Vol. 221, No. 4609, p 457-459, July, 1983. 1 Fig, 1 Tab, 12 Ref.

Descriptors: *Water analysis, *Silica, *Lake Michigan, Chicago, Water treatment facilities, Chemical composition, Lakes.

Data obtained from water treatment plants on Lake Michigan were analyzed to see whether a trend could be documented regarding silica concentration in the lake. The analysis was made of the longest post-1948 periods of consistent SiO2 analysis at Chicago, which were 1949-1967 and 1971-1978. Municipal water analyses appear to document some trends, but the results continue to be equivocal on the question of whether Lake Michigan is experiencing progressive change in SiO2 concentration, dissolved or total. In the past, studies have been made which concluded that there was a decline in silica content in the lake. This effort suggests that this purported decline was due to changes in analytical methods and laboratories rather than due to a real change in the chemical composition of the lake's water. (Baker-IVI)
W84-01083

DETERMINATION OF CARBOSULFAN AND CARBOFURAN RESIDUES IN PLANTS, SOIL, AND WATER BY GAS CHROMATOGRAPHY,
FMC Corp., Richmond, CA. Agricultural Chemical Group.
B. C. Leppert, J. C. Markle, R. C. Helt, and G. H. Fujie.
Journal of Agricultural and Food Chemistry, Vol. 31, No. 2, p 220-223, March-April, 1983. 3 Fig, 1 Tab, 8 Ref.

Descriptors: *Pesticide residues, *Chemical analysis, Water analysis, *Carbosulfan, *Carbofuran, Gas chromatography, Soil contamination, *Pollutant identification.

Analytical procedures are described for the determination of carbosulfan and carbofuran residues in various crops, in soil, and in water. The quantitative methods involve extraction of residues using hexane-2-propanol or methanol-buffered water followed by column cleanup using Florisil, gel permeation, and Darco-Attaclay plus aluminum oxide, each column alone or in combination with each other. Residues of carbosulfan and carbofuran are detected by gas-liquid chromatography using a nitrogen-selective detector. Good recoveries are achieved with check samples fortified at the 0.05-ppm level with crops and soil and at the 0.01-ppm level with water. (Author's abstract)
W84-01093

PHOTOLYSIS OF THE AQUATIC HERBICIDE FLURIDONE IN AQUEOUS SOLUTION,
Lilly (Eli) and Co., Indianapolis, IN. Lilly Research Lab.
For primary bibliographic entry see Field 5B.
W84-01094

MULTIELEMENTAL AND HYDROCHEMICAL STUDY OF HOLY ZAMZAM WATER,
For primary bibliographic entry see Field 2K.
W84-01095

ENVIRONMENTAL APPLICATIONS OF CAPILLARY GC COLUMNS,
Versar, Inc., Springfield, VA.
S. M. Sonchik.
Journal of Chromatographic Science, Vol. 21, No. 3, p 106-110, March, 1983. 7 Fig, 17 Ref.

Descriptors: *Water analysis, *Pollutant identification, *Gas chromatography, *Capillary analysis, Hazardous materials, Hydrocarbons, *Polychlorinated biphenyls.

Several environmental applications of capillary gas chromatography (GC) analysis using the high resolution achieved with open tubular columns are presented. Suspected environmental problems in landfills, abandoned or active sites, can be verified through the identification of a hydrocarbon layer found on drainage ditch water or in well water using a GC determination of the range of hydrocarbon boiling points to distinguish between gasoline, kerosene, jet fuel or heating oil. The high resolution of the complex hydrocarbon mixture can identify the spill source through careful comparison with possible source materials for subtle differences in mixtures. High resolution GC has also been used in the analysis of PCBs in complex environmental matrices and in the analysis of priority pollutants where the speed of the analysis is important. Not only is capillary analysis quicker than the analysis by packed-column GC/MS, but the fused silica column has the additional advantage of being able to extend directly to the MS ion source. An additional application is in the identification of combustion products from Thermal Destruction Units requiring high resolution separation of the chemical compounds. (Baker-IVI)
W84-01096

THE PRACTICAL APPLICATION OF SURFACE ELECTRICAL RESISTIVITY TO DETECTION OF GROUND-WATER POLLUTION,
Rhode Island Univ., Kingston. Dept. of Civil and Environmental Engineering.
D. W. Urish.
Ground Water, Vol. 21, No. 2, p. 144-152, March-April, 1983. 8 Fig, 1 Tab, 19 Ref. OWRT A-061-RI.

Descriptors: *Groundwater pollution, *Resistivity, *Electrical properties, *Pollutant identification, Field investigations, Brines, Industrial wastes, Leachates, New England.

One of the primary problems in field investigations of ground-water pollution is locating the contaminant plume. Drilling of sampling holes on a hit-or-miss basis is both time-consuming and expensive. Under many subsurface conditions, surface electrical resistivity profiling can quickly and cheaply locate the general position of the plume and identify areas most feasible for sampling and monitoring. Many contaminants contain an ionic concentration considerably higher than the background level of native ground water. When such a contaminant is introduced into an aquifer, the electrical resistivity of the saturated soil is reduced. Surface electrical resistivity profiling across a suspected area can identify this reduced resistivity zone as an anomaly. The sensitivity of the method depends on relative uniformity of geology and topography as well as minimal extraneous electrical interferences. It is also essential that the 'A' spacing used in the profiling procedure be carefully selected. If the resistivity contrast between contaminated and uncontaminated ground water is high, detection of at least the central part of the plume is likely within expected geologic variation. The method has been successfully used in the location of plumes from contaminants including brine, uranium reprocessing liquid wastes and landfill leachate in glacial deposits of New England. (Author's abstract)
W84-01122

ACIDITY IN AIR AND WATER IN A CASE OF WARM FRONTAL PRECIPITATION,
National Center for Atmospheric Research, Boulder, CO.
A. L. Lazrus, P. L. Haagenson, G. L. Kok, B. J. Huebert, and C. W. Kreitzberg.
Atmospheric Environment, Vol. 17, No. 3, p 581-591, 1983. 9 Fig, 5 Tab, 29 Ref.

Descriptors: *Acid rain, *Chemical composition, Clouds, Ohio River Valley, Precipitation, Hydrogen sulfide, Sulfates, Nitric acid, Ammonia, Acidity.

The chemical composition of dry air just prior to ascending a surface warm front moving through the Ohio River Valley was determined. The pH of the warm frontal precipitation near cloud base was 4.0. Though the acid content of the air was sufficient to produce pH 4.0 in 1 g of cloud water condensing from 1 cu of air, the overall composition of the air was inconsistent with that of the rain at cloud base. The agreement between the pH of the air and the pH of the rain at cloud base suggests that the amount of pre-existing acids rained out in the early stage of precipitation was comparable to the observed amount of the acid generated in the cloud and observed in 1 g of cloud water. Both nitric and sulfuric acids appear to be generated in clouds, in spite of the low solubility of NO2. The average pH of the rain at cloud base was 4.02, while the overall average pH of the warm frontal rain at ground level was 4.12. The acidity of the precipitation falling from the cloud largely inhibited the removal of SO2 or the scavenging of acidic aerosols, HNO3 vapor or ammonia vapor below the cloud. The acid concentration in the rain at ground level appeared inversely related to rainfall rate. However, the acid deposition rate was relatively unchanged. (Baker-IVI)
W84-01127

SENSITIVITY ANALYSIS OF THE KINETICS OF ACID RAIN MODELS,
Massachusetts Inst. of Tech., Cambridge. Energy Lab.
D. Golomb, S. Batterman, J. Gruhl, and W. Labys.
Atmospheric Environment, Vol. 17, No. 3, p 645-653, 1983. 13 Fig, 2 Tab, 10 Ref. EPRI contract RP1484-1.

Descriptors: *Acid rain, *Sulfur compounds, *Nitrogen compounds, *Mathematical models, Kinetics, Oxidation, Sulfur dioxide, Nitrogen oxides, Water pollution sources.

The great number of variables in acid rain modeling makes it difficult to pinpoint those parameters to which the model output (rain acidity) is most sensitive. The approach taken here separates the kinetic and dynamic parts, and analyses the sensitivity of the kinetic model alone. Further simplifi-

cations and linearizations are introduced; however, the essential steps of the transformation processes are believed to be preserved. The major conclusions are: (a) rain acidity is most sensitive to both the oxidation rates of SO2 to SO4(2-) and NOx to NO3(-); (b) dry deposition of the emitted gases, but not the formed anions, is important in determining the wet-deposition fraction; (c) wet deposition is much faster than oxidation, and acidic matter is removed very rapidly from the air, but it is the oxidation rate that determines the total amount of acidity in rain and (d) for similar initial concentrations of SO2 and NOx, nitrate ions may be the predominate species in wet deposition due to the faster oxidation and slower dry deposition of NOx compared to SO2. (Author's abstract)
W84-01128

ON-LINE TRACE ENRICHMENT OF DIFENZOQUAT IN WATER AND ITS DETERMINATION BY HPLC,
Alberta Environmental Center, Vegreville.
I. Ahmad.
Journal of Environmental Sciences and Health, Vol. B18, No. 2, p 207-219, April, 1983. 4 Fig, 1 Tab, 5 Ref.

Descriptors: *Difenzoquat, *Pesticide residues, *Chromatography, Herbicides, Chemical analysis, Water analysis, High performance liquid chromatography.

Difenzoquat is used throughout the world as a selective herbicide for the post emergence control of wild oats in barley and fall-seeded wheat. It is a quarternary ammonium salt which is highly soluble in water and which partitions strongly in favor of water. A high performance liquid chromatographic method involving an integrated enrichment step is described for the quantitative determination of low levels of difenzoquat residues in water. Difenzoquat is trapped from the flowing water sample by strong adsorption onto the enrichment column. It is then desorbed, separated, and subsequently analyzed in a single step process by reserve phase high performance liquid chromatograpy using ultraviolet detection at 255 nm. Average recovery of difenzoquat from organic free water at spiking levels of 20, 10 and 5 ppb was 97.0%. The lower detection limit reached was 0.25 ppb difenzoquat in organic free water. (Moore-IVI)
W84-01180

SIMULTANEOUS DETERMINATION OF NITRATE, CHLORIDE, SULFATE, AND PHOSPHATE IN NATURAL WATERS BY ION CHROMATOGRAPHY,
Iowa State Univ., Ames. Dept. of Agronomy.
M. A. Tabatabai, and W. A. Dick.
Journal of Environmental Quality, Vol. 12, No. 2, p 209-213, April-June, 1983. 7 Fig, 1 Tab, 10 Ref.

Descriptors: *Chromatography, *Chemical analysis, Anions, Water analysis, Nitrates, Chloride, Sulfates, Phosphates, Soil analysis.

Simultaneous analysis of anions in water samples is needed. Studies to evaluate the Dionex Model 10 Ion Chromatogaph (IC) for simultaneous determination of N03(-), Cl(-), SO4(2-), and PO4(3-) in water samples, including soil extracts, showed that the results by the IC method agreed closely with those obtained by the steam-distillation method for NO(3-), colorimetric method using mercuric thiocyanate and ferric ammonlum sulfate for Cl(-), reduction and colorimetric determination as methylene blue for SO4(2-), and colorimetric molybdenum blue method for PO4(3-). The IC method is based on separation of the anions by a separator column containing Dionex low-capacity anion-exchange resin in the HCO3(-) form and on converting the various anions to their corresponding acids by a suppressor column containing a strong acid cation-exchange resin in the H(+) form. A solution 3.0 mM NaHCO3 + 2.4 mM Na2CO3 is used as the eluent, and electrical conductivity is used as the mode of detection. The method is precise and accurate, and can detect as little as 0.1 mg/L of NO3(-)-N, Cl(-), SO4(2-)-S, or PO4(3-)-P in water samples. The coefficient of variation ranged from 0.44 to 8.6% for NO(3-)-N, from 0.14 to 4.3% for Cl(-), from 0.13 to 1.1% for SO4(2-)-S, and from 0.55 to 8.6% for PO4(3-)-P. With the IC method, the 4 anions indicated can be determined simultaneously in 2 mL of water in approximately 10 min. (Author's abstract)
W84-01197

ROUTINE COLIFORM MONITORING AND WATERBORNE DISEASE OUTBREAKS,
Columbia Univ., New York. School of Medicine.
For primary bibliographic entry see Field 5F.
W84-01204

MINERALIZATION OF ORGANIC MATTER IN WATER BY U.V. RADIATION,
Ceskoslovenska Akademie Ved, Prague. Hydrobiologicka Lab.
P. Blazka, and L. Prochazkova.
Water Research, Vol. 17, No. 4, p 355-364, April, 1983. 9 Fig, 8 Tab, 23 Ref.

Descriptors: *Mineralization, *Ultraviolet radiation, Water analysis, Hydrogen ion concentration, Carbon dioxide, Oxidation process.

The conditions for the optimum yield of carbon dioxide in the mineralization of organic matter in water were tested and the relative optimum procedure was outlined. Of all substances tested the greatest difficulties were encountered with the purine bases. Their quantitative mineralization was achieved only by the highest irradiation intensities and/or prolonged irradiation. An evident relationship of mineralization and pH was found in urea and thiourea. Adsorption of proteins on silica and glass apparatus was suppressed by phosphoric acid, but a correction of the amount of organic carbon recovered in the blank still had to be applied in protein rich samples. (Author's abstract)
W84-01265

A SENSITIVE METHOD FOR MEASURING ORGANIC CARBON IN SEDIMENT,
Tokyo Univ. (Japan). Faculty of Pharmaceutical Sciences.
J. Suzuki, Y. Yokoyama, Y. Unno, and S. Suzuki.
Water Research, Vol. 17, No. 4, p 431-434, April, 1983. 2 Fig, 3 Tab, 8 Ref.

Descriptors: *Organic carbon, *Sediments, River beds, Analytical methods, Pollutant identification, Solvent extraction.

In order to determine organic carbon in sediments, a sensitive method was devised by the combination of an ordinary wet combustion and TOC analyzer for aqueous samples. The carbon dioxide evolved by wet combustion was absorbed into 0.2 N NaOH solution and determined with a TOC analyzer. The accuracy and the determination limit of the method were determined. Carbon ranges from 0.4 to 48 mg were determined accurately without interference of chlorine and sulfur. This method was applied to the study of the composition of river sediment on the basis of extractability by various solvents. (Author's abstract)
W84-01272

VELOCITY EQUATION FOR WATER QUALITY MODELING IN GEORGIA,
Georgia Dept. of Natural Resources, Atlanta. Environmental Protection Div.
R. Burke, III.
Water Resources Bulletin, Vol. 19, No. 2, p 271-276, April, 1983. 3 Fig, 2 Tab, 12 Ref.

Descriptors: *Hydrologic models, *Water pollution control, *Statistical analysis, *Georgia, Physiographic provinces, Stream discharge, Soil types, Velocity, Mathematical studies.

Tabletop water quality modeling still plays an important role in the water pollution control activities of the Georgia Environmental Protection Division. Tabletop models are those developed without the aid of extensive field data. One important component of GEORGIA DOSAG, our basic water quality model, is the equation used to predict flow through velocity. However, Georgia is characterized by wide physiographic diversity which reduces the effectiveness of uncalibrated velocity equations. Using 15 years of accumulated time-of-travel studies, a series of empirical velocity equations were developed and calibrated to various physiographic conditions in Georgia. Equations are available for each major soil province and for three stream flow ranges within each province - $Q<100$cfs, $100<Q<1000$ cfs, and $Q>1000$ cfs. Now, in the absence of extensive field data, we have data based velocity equations which can be tailored to each site under study. (Author's abstract)
W84-01277

PREDICTION OF CHLOROPHYLL A CONCENTRATIONS IN FLORIDA LAKES: THE IMPORTANCE OF PHOSPHORUS AND NITROGEN,
Florida Univ., Gainesville. School of Forest Resources and Conservation.
D. E. Canfield, Jr.
Water Resources Bulletin, Vol. 19, No. 2, p 255-262, April, 1983. 2 Fig, 3 Tab, 39 Ref.

Descriptors: *Chlorophyll a, *Nitrogen, *Phosphorus, Florida, Eutrophic lakes, Mathematical models, Limiting nutrients, Algal growth.

Models for the prediction of chlorophyll a concentrations were developed and tested using data on 223 Florida lakes. A statistical analysis showed that the best model was log (Chl a)= -2.49 + 0.269 log (TP) + 1.06 log (TN/TP) + 1.33 log (TP) where Chl a is the chlorophyll a concentration (mg/cu m), TP is the total phosphorus concentration (mg/cu m) and TN is the total nitrogen concentration (mg/cu m). The model yields unbiased estimates of chlorophyll a concentrations over a wide range of lake types and has a 95% confidence interval of 29-319 percent of the calculated chlorophyll a concentrations. Other models, especially the published Dillon-Rigler and Jones-Bachmann phosphorus-chlorophyll models, are less precise when applied to Florida lakes. The data support the hypothesis that nitrogen is an important limiting nutrient in hypereutrophic lakes. (Author's abstract)
W84-01278

BIOLOGICAL MONITORING OF BLUEGILL ACTIVITY,
Air Force Environmental Hazards Branch, Wright-Patterson AFB, OH. Toxic Hazards Div.
J. W. Fisher, R. A. Dilego, M. E. Putnam, J. M. Livingston, and D. L. Geiger.
Water Resources Bulletin, Vol. 19, No. 2, p 211-215, April, 1983. 3 Fig, 1 Tab, 11 Ref.

Descriptors: *Bluegills, *Bioindicators, *Water pollution effects, Hydrocarbons, Fish behavior, Monitoring, Water quality.

Bluegills were exposed for one hour to 0.2 or 2.3 mg/liter water soluble fraction (WSF) of JP-4 in a testing chamber designed to contain individual fish. A strain gage paddle was used to monitor activity. Whole body movement of individual fish did not change appreciably during exposure to either 0.2 or 2.3 mg/liter WSF-JP-4. Strength of pectoral fin movement, accounting for the majority of the fish behavior, increased in six of ten individuals exposed to 2.3 mg/liter WSF-JP-4. Pectoral fanning may be a useful parameter to indirectly assess water quality. (Author's abstract)
W84-01285

USE OF THE FRESHWATER CLAM CORBICULA MANILENSIS AS A MONITOR FOR ORGANOCHLORINE PESTICIDES,
Montgomery (James M.), Inc., Pasadena, CA.
D. M. Hartley, and J. B. Johnson.
Bulletin of Environmental Contamination and Toxicology, Vol. 31, No. 1, p 33-40, July, 1983. 2 Fig, 1 Tab, 25 Ref.

Descriptors: *Pesticides, *Clams, *Monitoring, Chlorinated hydrocarbons, Biological magnification, Bioindicators.

Among the bivalve species in American freshwaters is the Asiatic clam, Corbicula manilensis.

Corbicula offers several advantages as an organism for toxicity testing. It tolerates removal from water for reasonably long periods of time, it can be easily handled in the laboratory and it survives in aquaria without food for periods of up to 6 mo. The bioaccumulation of organochlorine pesticides by Corbicula taken for natural bed, incubated in an aquarium to permit self-cleaning and temporarily implanted in cages in a river was assayed in order to explore the use of temporarily implanted Corbicula for measurement of persistent pollutants in freshwater environments. Eight pesticides, aldrin, dieldrin, hexachlorocyclohexane, lindane, alpha-chlordane, gamma-chlordane, heptachlor, and heptachlor epoxide, were bioconcentrated in clam fat. A period of at least 18 days was required before pesticides in the clam fat came to equilibrium with the pesticide in the water. (Moore-IVI)
W84-01293

USE OF CHROMATICITY IN REMOTE MEASUREMENTS OF WATER QUALITY,
R. P. Bukata, J. E. Bruton, and J. H. Jerome.
Remote Sensing of Environment, Vol. 13, No. 2, p 161-177, May, 1983. 14 Fig, 20 Ref.

Descriptors: *Remote sensing, *Water quality, Lake Ontario, Upwelling, Turbidity, Chromaticity, Chlorophyll a, Organic carbon, Minerals, Optical properties.

The optical cross sections for Lake Ontario water masses have been utilized to study the use of chromaticity analyses for predicting water quality parameters in a water mass which is comprised of chlorophyll, suspended mineral, and dissolved organic carbon (DOC) concentrations. The analyses appear to indicate a very restricted range of such applications. For water masses containing substantial amounts of chlorophyll a or suspended mineral, chromaticity analyses are almost totally ambiguous even if the DOC concentration is known. If the DOC concentration is either known or may be inferred, chromaticity analyses may provide a distinction between clear and turbid waters, but the concentration creating the turbidity would be in doubt. For water masses in which the suspended mineral concentration is know to be moderate, and the DOC concentration is either know or can be estimated, small concentrations of chlorophyll a may be estimated to within a factor of 2. (Moore-IVI)
W84-01300

KEEPING TABS ON EXCESS CHLORINE,
For primary bibliographic entry see Field 7B.
W84-01319

EVALUATION OF EXTRACTION TECHNIQUES FOR THE DETERMINATION OF HEAVY METALS IN RIVER SEDIMENTS,
Gifu Prefecture Research Inst. for Environmental Pollution, Yabuta (Japan).
N. Watanabe, Y. Yasuda, K. Kato, T. Nakamura, and K. Shimokawa.
Japanese Journal of Limnology, Vol. 44, No. 2, p 123-131, April, 1983. 7 Fig, 3 Tab, 25 Ref.

Descriptors: *Heavy metals, *Sediments, Extraction, Water pollution, Copper, Lead, Cadmium.

In order to distinguish whether heavy metal contents originate from a rock matrix or pollution, six different extraction techniques for copper, lead and cadmium were studied in Nagara River sediments in Gifu Prefecture, Japan. The extraction agents were hydrochloric-nitric acid mixture (1+1), 3N hydrochloric acid solution, 0.5N hydrochloric acid solution, 6 M formic acid solution, 1N hydroxylamine hydrochloride plus 25% acetic acid solution and 0.05N ethylenediaminetetraacetic acid solution. The comparison of the six extraction techniques was conducted on the basis of the heavy metal contents originating from pollution, which was estimated by subtracting background values from total contents. For copper, 3N hydrochloric acid is preferable, but in sediments with poor ignition loss, 0.5N hydrochloric acid and 6M formic acid are recommended. 1N hydroxylamine hydrochloride plus 25% acetic acid is suitable for lead and cadmium. (Author's abstract)
W84-01375

5B. Sources Of Pollution

NEPTUNIUM AND AMERICIUM SPECIATION IN SELECTED BASALT, GRANITE, SHALE, AND TUFF GROUND WATERS,
Geological Survey, Denver, CO.
J. M. Cleveland, T. F. Rees, and K. L. Nash.
Science, Vol. 221, No. 4607, p 271-273, July, 1983. 5 Tab, 6 Ref.

Descriptors: *Waste disposal, *Radioactive wastes, *Speciation, Nuclear powerplants, Americium, Neptunium, Groundwater contamination, Basalts, Sulfates, Granites.

The chemical speciation of neptunium and americium in groundwaters associated with rock types proposed as possible hosts for nuclear waste repositories was examined. The waters used were from the Grande Ronde basalt on the Hanford reservation in Washington, Climax stock granite and tuff from the Nevada Test Site, Cretaceous shale from a rural well near Rapid City, South Dakota, and, for comparison, deionized water. Mobilization of the actinides Np(IV), Np(V), Am(III), and Pu(III) in these groundwaters was minimized by reducing conditions and by high concentrations of sulfate ion, but it is uncertain whether the effect of sulfate could prevail in all groundwaters. The presence of high concentrations of free fluoride had no discernible effect on neptunium and americium solubilities. Since characteristics of chemical composition vary with location within any given host rock type and hence are site specific, it is proposed that the chemical composition of the associated ground water and actual speciation experiments be included along with other relevant parameters as criteria in the selection of geologic sites as possible repositories for nuclear waste. (Baker-IVI)
W84-01086

PHOTOLYSIS OF THE AQUATIC HERBICIDE FLURIDONE IN AQUEOUS SOLUTION,
Lilly (Eli) and Co., Indianapolis, IN. Lilly Research Lab.
D. G. Saunders, and J. W. Mosier.
Journal of Agricultural and Food Chemistry, Vol. 31, No. 2, p 237-241, March-April, 1983. 7 Fig, 3 Tab, 12 Ref.

Descriptors: *Fluridone, *Herbicides, *Photolysis, Lakes, Pollutants, *Pollutant identification, Chemical analysis.

The parameters affecting the photolysis of the aquatic herbicide fluridone, in water are evaluated. The photolysis of fluridone and the formation of benzaldehyde and benzoic acid photoproducts and N-methylformamide were observed in lake and distilled water exposed to sunlight for up to 27 days. The concentration of N-methylformamide increased steadily with 74 and 36% of theory, respectively, being present in the distilled and lake water after 27 days of exposure. In lake water, 3-(trifluoromethyl)benzoic acid and benzoic acid increased steadily, reaching maximums of 33 and 40%, respectively after 21 days. Only trace amounts of the benzaldehydes were observed in both lake and distilled water after 7 days of exposure, and no benzaldehydes were detected after the 14th day. Fluridone half-lives ranged from 22 to 55 hr and were only slightly dependent on fluridone concentration, oxygen concentration, and pH. Results of photolysis experiments with the photoproducts of fluridone are also presented. (McKeon-IVI)
W84-01094

THE REGIONAL EFFECTS OF THE EFFLUENTS FROM THE MISHRAQ SULPHUR MINES IN IRAQ ON THE HYDROLOGICAL SYSTEM,
Mosul Univ. (Iraq).
H. Al-Dabbagh, and M. A. S. Al-Dabbagh.
Hydrological Sciences Journal, Vol 28, No 2, p 311-317, June, 1983. 5 Fig, 3 Ref.

Descriptors: *Sulfur, *Mine wastes, Hydrologic aspects, *Mishraq, *Iraq, *Permeability coefficient, Observation wells, Groundwater movement, Injection wells.

Sulfur is mined at Mishraq near Mosul, Iraq, by the injection of superheated water. The production area is adjacent to and in contact with the River Tigris. With time an increasing number of hot sulfur springs have erupted in and near the river. Geological and hydrological studies have shown that faults, fractures and cavities in the predominantly limestone rocks increase the hydraulic conductivity and seepage coefficient. The most effective method of controlling the large-scale flow of sulfur into the river was by pumping a barrier of cold water into observation wells bored into areas of high hydraulic conductivity, in order to solidify the sulfur. (Author's abstract)
W84-01105

DISTRIBUTION OF KEPONE IN THE JAMES RIVER ESTUARY,
Manhattan Coll., Bronx, NY. Environmental Engineering and Science Program.
D. J. O'Connor, J. A. Mueller, and K. J. Farley.
Journal of Environmental Engineering, Vol. 109, No. 2, p 396-413, April, 1983. 13 Fig, 15 Ref. EPA grant R-804563.

Descriptors: *Kepone, *James River, *Estuaries, *Mathematical models, *Path of pollutants, Pesticide kinetics, Spatial distribution, Temporal distribution, Sediments, Virginia.

An analysis is presented defining the distribution of an organic chemical in the water and bed of an estuarine system. The present structure of the model is a tidally averaged two-dimensional (longitudinal-vertical) main channel interacting with lateral embayments. The water column, segmented into two layers to incorporate the typical estuarine circulation, interacts with a bed which is also segmented into two layers, an active transport layer and a deeper stationary bed. Adsorption-desorption kinetics are included which, in the case of Kepone distribution of the James River, are assumed to be at equilibrium. Both steady-state as well as time-variable conditions are analyzed to calibrate the model to reproduce presently observed concentrations of Kepone. A procedure of analysis to address the problem of organic chemicals in estuaries has been structured. The procedure involves a series of analytic and computational steps, relating to the fluid transport, the solids distribution, and the concentrations of the organic chemical in the water and the bed. The model has been applied to analyze the temporal and spatial distribution of Kepone in the James River under both constant and time-variable freshwater flow conditions. Using actual hydrology and an assumed mass rate of input of Kepone, the concentration was calculated for a 10-yr period of production, comparing well to observed values in the water and bed. Projections are presented to estimate the mass contained in the bed and that discharged to Chesapeake Bay. (Author's abstract)
W84-01107

GROUND-WATER TRANSPORT FROM WASTEWATER INFILTRATION,
Rice Univ., Houston, TX. Dept. of Environmental Science and Engineering.
P. B. Bedient, N. K. Springer, E. Baca, T. C. Bouvette, and S. R. Hutchins.
Journal of Environmental Engineering, Vol. 109, No. 2, p. 485-501, April, 1983. 7 Fig, 3 Tab, 23 Ref. EPA grant CR806931-01.

Descriptors: *Groundwater pollution, *Wastewater pollution, *Mathematical models, Conductivity, Organic compounds, Wastewater disposal, Chlorides, Simulation, Dispersion, Massachusetts.

Ground water contaminant transport was investigated from a municipal wastewater infiltration system. Ground water quality samples were collected at the Fort Devens, Massachusetts facility from surrounding wells and were analyzed for conductivity and trace level organics contamina-

tion. Ground water flow and chloride contaminant transport were predicted using a two dimensional numerical simulation model. Dispersion estimates were made using organics data collected at adjacent wells and adjusted for adsorption in the porous media. Results for field dispersion compared favorably with other values reported in the literature. Methods used in this field project along with modeling techniques should be applicable to other ground water waste contaminant sites. (Author's abstract)
W84-01110

NUTRIENT LOADING ESTIMATES FOR LAKES,
Geological Survey, Sacramento, CA.
W. Rast, and G. F. Lee.
Journal of Environmental Engineering, Vol. 109, No. 2, p 502-517, April, 1983. 3 Fig, 2 Tab, 40 Ref.

Descriptors: *Nutrients, *Nitrogen, *Phosphorus, *Lakes, *Pollution load, Land use, Watersheds, Mathematical models, Nutrient load.

The nitrogen and phosphorus loads to a waterbody may be reliably estimated on the basis of the waterbody's watershed land use pattern and the nitrogen and phosphorus export coefficients for each dominant type of land use. Good agreement was found in a comparison between the nitrogen and phosphorus export coefficients developed in this study and the measured amounts of nitrogen and phosphorus transported to 38 U.S. waterbodies. Good agreement was also found between the load estimated by the Vollenweider model relating the mean annual in-lake and inflow phosphorus concentrations of a waterbody, and the measured amounts of phosphorus that actually entered the 38 waterbodies. (Author's abstract)
W84-01111

THE PRACTICAL APPLICATION OF SURFACE ELECTRICAL RESISTIVITY TO DETECTION OF GROUND-WATER POLLUTION,
Rhode Island Univ., Kingston. Dept. of Civil and Environmental Engineering.
For primary bibliographic entry see Field 5A.
W84-01122

ENUMERATION AND CHARACTERIZATION OF BACTERIA INDIGENOUS TO A SHALLOW WATER-TABLE AQUIFER,
Robert S. Kerr Environmental Research Lab., Ada, OK.
J. T. Wilson, J. F. McNabb, D. L. Balkwill, and W. C. Ghiorse.
Ground Water, Vol. 21, No. 2, p 134-142, March-April, 1983. 4 Fig, 2 Tab, 7 Ref.

Descriptors: *Bacteria, *Groundwater pollution, *Biodegradation, *Organic compounds, Toluene, Chlorobenzene, Bromodichloromethane, Saturation zone, Vadose water, Soil bacteria, Aquifers, Oklahoma.

Regions of the earth below the root zone of soil have conventionally been considered void of life. However, widespread pollution of ground water in the U.S. by organic compounds has kindled interest in the numbers of microbes that might be found in aquifers and associated regions of the deeper unsaturated zone, and in their ability to degrade organic pollutants. Newly developed techniques in microbial ecology allow the direct enumeration and examination of soil microbes without recourse to their cultivation on growth media. These techniques reduce many uncertainties associated with the use of culture media, such as the growth of contaminants or the failure of indigenous forms to grow on a particular medium. Samples were recovered aseptically from depths of 1.2, 3.0, and 5.0 meters (m) at the margin of a small floodplain near Lula, Oklahoma. Depth to the water table was 3.6 m; depth to bedrock was 6.0 m. Numbers of microbes were surprisingly similar at all three depths (3,000,000 to 9,000,000/g dry material). Although both Gram-positive and Gram-negative bacteria were encountered, small Gram-positive coccoid forms predominated. No protozoa, yeasts, or other fungi were seen. The indigenous bacteria could rapidly degrade toluene. Chlorobenzene was degraded in material from the vadose zone, while bromodichloromethane was degraded in material from the saturated zone. There was no detectable degradation of 1,2-dichloroethane, 1,1,2-trichloroethane, trichloroethylene, or tetrachloroethylene. (Author's abstract)
W84-01123

ACIDITY IN AIR AND WATER IN A CASE OF WARM FRONTAL PRECIPITATION,
National Center for Atmospheric Research, Boulder, CO.
For primary bibliographic entry see Field 5A.
W84-01127

SENSITIVITY ANALYSIS OF THE KINETICS OF ACID RAIN MODELS,
Massachusetts Inst. of Tech., Cambridge. Energy Lab.
For primary bibliographic entry see Field 5A.
W84-01128

INTERACTION BETWEEN CO-SOLVENTS AND ALGAE IN THE RESIDUE DYNAMICS OF FENITROTHION,
Ottawa Univ. (Ontario). Dept. of Biology.
P. Weinberger, D. Sher, and R. Greenhalgh.
Journal of Environmental Sciences and Health, Vol. B18, No. 2, p 269-281, April, 1983. 4 Fig, 1 Tab, 8 Ref.

Descriptors: *Algae, *Pesticide residues, *Fate of pollutants, Fenitrothion, Bioaccumulation, Chlorophyta, Biodegradation, Solvents.

The specificity of pesticide effects coupled with high rates of pesticide accumulation noted for a range of genera of green algae have been explained as a function of passive partitioning of lipophylic xenobiotics into the lipid pools of the exposed organisms. This study was undertaken to determine whether this totally passive role for the aquatic phytobiota was correct. Fresh and estuarine water algae maintained in laboratory microcosms simulating river-lake/estuary-bay systems were exposed to C14-fenitrothion formulated with Atlox and tank mixed with Aerotex or Dowanol (11.5:1.5:15.5 w/v/v). Generally, the tank mix cosolvents determined the amount of uptake and the array of derivatives formed by the algae. Typically, exposed to an Aerotex mix the ratio of ethyl acetate extractable (NP) fraction : ethyl acetate unextractable (P) fraction was as 3.5:1.0, exposed to a Dowanol mix the ratio was as 1.5:1.0. Within any comparable time period, fresh water algae turned over more of the C14-ring of fenitrothion than the estuarine genera. Turn-over was enhanced when Aerotex was the tank mix co-solvent. Differences in uptake, turn-over, and degradation indicate that algae should be regarded as active rather than passive sinks. (Moore-IVI)
W84-01175

FURTHER WATER SOLUBILITY DETERMINATIONS OF INSECTICIDAL COMPOUNDS,
Department of Agriculture, London (Ontario). Research Centre.
B. T. Bowman, and W. W. Sans.
Journal of Environmental Science and Health, Vol. B18, No. 2, p 221-227, April, 1983. 1 Tab, 14 Ref.

Descriptors: *Insecticides, *Fate of pollutants, *Solubility, Fenamiphos, Fenthion, Methidathion, Carbaryl, Carbophenothion, Aminocarb, Diazinon, Dicapthon, Pirimiphos-ethyl, Pirimiphos-methyl.

The aqueous solubility of 39 pesticides and related compounds was determined at 20 + or - 1.5 C. All samples were analyzed by gas-liquid chromatography. Fenamiphos, fenthion and methidathion had solubilities substantially less than those reported in the literature. Carbaryl and carbophenothion had conflicting literature values, of which one for each compound agreed reasonably well with present data. Aminocarb, diazinon, dicapthon, pirimiphos-ethyl and pirimiphos-methyl gave solubilities substantially greater than their reported literature values. It is hoped that these solubility values will be of use in predicting the environmental fate of insecticides. (McKeon-IVI)
W84-01176

WATER AND NITRATE-NITROGEN LOSSES FROM A SMALL, UPLAND, COASTAL PLAIN WATERSHED,
Agricultural Research Service, Tifton, GA. Southeast Watershed Research Center.
For primary bibliographic entry see Field 2A.
W84-01188

ATMOSPHERIC SULFUR DEPOSITION, NEUTRALIZATION, AND ION LEACHING IN TWO DECIDUOUS FOREST ECOSYSTEMS,
Oak Ridge National Lab., TN. Environmental Sciences Div.
D. D. Richter, D. W. Johnson, and D. E. Todd.
Journal of Environmental Quality, Vol. 12, No. 2, p 263-270, April-June, 1983. 4 Fig, 3 Tab, 51 Ref. RP-1813-1, W-7405-eng-26, DEB-7824395.

Descriptors: *Acid rain, *Leaching, *Hydrogen ion concentration, *Deciduous forests, *Forest soils, Sulfates, Nutrient cycling, Litter, Neutralization, Tennesee.

In the 1981 water year, bulk precipitation was primarily a solution of dilute H_2SO_4, and SO_4^{2-} was the dominant anion in throughfall and soil leachates in two eastern Tennessee deciduous forests. Ecosystems inputs of SO_4^{2-}, which included dry deposition of forest canopies, may have been up to 40% greater than input estimates based on atmospheric deposition sampling in open areas. Volume- weighted mean annual pH of bulk precipitation was 4.3; of throughfall 4.8; and of leachates from O2, A1, and B21 soil horizons about 6.0. At both sites, strong acids in precipitation were largely neutralized prior to rainwater's infiltration into mineral soil. Base cations that exchanged with H(+) (hydrogen ions) in acid precipitation were almost entirely supplied by forest canopies and litter layers, and did not come directly from exchangeable mineral soil pools. However, even in these infertile soils with low cation exchange capacities, exchangeable bases were more than two orders of magnitude greater than annual H(+) input in bulk precipitation, and represented a substantial reserve for base cations in canopies and litter layers that exchanged with H(+) in acid rain. Furthermore, inputs of H(+) from acid precipitation were equal to about 0.4% of the base cations that are biologically cycling and immediately available in these ecosystems. Both soils are base-poor Udults and classified as sensitive to acid rain, but the deposition, cycling, and soil data presented in this report indicate that leaching remains a process affecting cation reserves and soil development only over the very long term. (Moore-IVI)
W84-01190

NITROGEN-15-LABELED NITRATE TRANSPORT IN A SOIL WITH FISSURED SHALE SUBSTRATUM,
Griffith Univ., Nathan (Australia). School of Australian Environmental Studies.
C. W. Rose, F. W. Chichester, and I. Phillips.
Journal of Environmental Quality, Vol. 12, No. 2, p 249-252, April-June, 1983. 2 Fig, 1 Tab, 16 Ref.

Descriptors: *Nitrates, *Leaching, *Path of pollutants, Shale, Solute transport, Geologic fractures, Groundwater storage, Fertilizers.

Published data on the fate of N15-labeled fertilizer applied to 4 Coshocton, Ohio, monolith lysimeters showed a series of declining NO_3^- - N concentration maxima in the lysimeter percolate during 3 winter drainage periods subsequent to the single 336 kg/ha fertilizer application. A possible explanation of these concentration maxima as arising from the leaching of previously immobilized and subsequently mineralized N was quantitatively inadequate. In this study, an alternative explanation of these observations was sought. The lowest meter in the 2.44-m deep monolith profile of Keene silt loam consisted of fissured shale bedrock, and analysis of mass conservation of N15-labeled inor-

ganic N in the fissured layer provided an explanation of these observed annually periodic concentration maxima. Some of the calculated flux of labeled N into the top of the fissured layer was shown to be stored within the layer, and to reappear in subsequent annual winter drainage periods. Two possible mechanisms, which allowed such temporary storage, were identified: storage within the pore space of the crack system, and storage in micropores of the weathered rock by lateral diffusion from solution contained in the cracks. (Author's abstract)
W84-01193

ADSORPTION OF DIURON AND 2,4,5-T ON SOIL PARTICLE-SIZE SEPARATES,
Florida Univ., Gainesville. Dept. of Soil Science.
P. Nkedi-Kizza, P. S. C. Rao, and J. W. Johnson.
Journal of Environmental Quality, Vol. 12, No. 2, p 195-197, April-June, 1983. 3 Fig, 2 Tab, 15 Ref. R-805529.

Descriptors: *Herbicides, *Adsorption, *Particle size, Soil contamination, Diuron, Sediments, Nonpoint pollution sources, Path of pollutants, Organic carbon, Agricultural runoff.

Adsorption is a major process that influences the environmental fate and transport of pesticides in soil-water systems. A major pathway for pesticide removal from croplands is via runoff. During a runoff event, the clay-size and silt-size fractions are selectively carried off the field along with the runoff water. Equilibrium isotherms for the adsorption of herbicides, diuron, and 2,4,5-T on whole soil and various-size separates of Webster soil (Typic Haplaquolls) were measured. The Freundlich adsorption coefficient, K, for diuron varied by a factor of about 7 among the different particle-size fractions. However, the sorption coefficient, K, normalized with respect to soil organic carbon (OC) content, denoted as Koc = (K/OC), varied only within a factor of 1.5. For 2,4,5-T herbicide, the Koc values for the silt and clay-size fractions, as well as the whole soil, were essentially identical and about 3 times larger than that for the sand-size fraction. The results suggested that the soil particle- size separates may be grouped into two size classes: 'fine' (< 50 micro m) and 'coarse' (2,000-50 micro m). For a given pesticide, a specific Koc value may be assigned to each class. (Moore-IVI)
W84-01199

RESPONSE OF SPRUCE AND BIRCH FOLIAGE TO LEACHING BY ACIDIC MISTS,
Vermont Agricultural Experiment Station, Burlington.
T. Scherbatskoy, and R. M. Klein.
Journal of Environmental Quality, Vol. 12, No. 2, p 189-195, April-June, 1983. 2 Fig, 2 Tab, 34 Ref.

Descriptors: *Acid rain, *Leaching, *Throughfall, Cycling nutrients, Metabolites, Precipitation, Birch, Spruce, Trees.

Seedlings of yellow birch (Betula alleghaniensis Britt.) and white spruce (Picea glauca (Moench) Voss) were exposed to mists consisting of distilled water at pH 5.7, or sulfuric acid in distilled water at pH 4.3 or 2.8. Misting treatments, 4 h each, were applied once, twice or three times, separated by 72 h. Leaf tissue chlorophyll concentrations were determined, and foliar leachate was analyzed for K(+), Ca(2+), NO3(-), H2PO4(-), total carbohydrate, total protein, and total amino acids. Decreased leaching of carbohydrate, protein, K(+), and H2PO4(-) occurred with increasing number of mistings, indicating that these substances were not readily resupplied to leaching sites. Protein leaching was reduced by misting at pH 2.8. Leaching of amino acids, K(+), and Ca(2+) increased with decreasing mist pH, and leachate pH was higher than the pH of applied mists, suggesting that cation exchange plays a role in foliar leaching by acidic solution. Amino acid leaching from birch increased with increasing number of mistings at pH 2.8. There was no strong effect on chlorophyll concentrations, and leaching of NO3(-) and H2PO4(-) did not vary with mist pH. (Author's abetract)
W84-01200

CONTINUED STUDIES OF ACID RAIN AND ITS EFFECTS ON THE BATON ROUGE AREA,
Louisiana State Univ., Baton Rouge. Dept. of Chemistry.
J. W. Robinson, and H. Ghane.
Journal of Environmental Science and Health, Vol. A18, No. 2, p 165-174, 1983. 7 Fig, 1 Tab, 7 Ref.

Descriptors: *Acid rain, *Water pollution effects, Baton Rouge, Louisiana, Surface drainage, Wind, Water pollution sources, Dissolved oxygen, Seasonal variation, Lakes, Rainfall.

The acidity of rain water was measured in the Baton Rouge, Louisiana area from June 1981 to September 1982. Coordinated measurements were taken of the dissolved oxygen concentration in two local lakes before and after each rainfall. About 50% of the rainfall observed was quite acidic, with about 25% of the rain having a pH of 4 or less. Rain was more acidic during warm summers than in the winter weather. Rainfall during 1982 was, on a month to month comparison, more acidic than in 1981. Attempts were also made to discover any possible correlation of pH values with wind direction. The acidity of each of the two lakes increased over the time of the study. The dissolved oxygen content in each lake increased after periods of rain, probably due to a high concentration of oxygen in the rainwater. The buffering capacities of the lakes was measurable. However, it is noted that the larger lake was undergoing dredging at the time of the study and showed considerably less buffer capacity than the smaller lake. The smaller lake was far more affected by surface drainage and thus should have been more influenced by the acid rain. (Baker-IVI)
W84-01211

ASSESSMENT OF THE CHEMICAL AND BIOLOGICAL SIGNIFICANCE OF ARSENICAL COMPOUNDS IN A HEAVILY CONTAMINATED WATERSHED PART II. ANALYSIS AND DISTRIBUTION OF SEVERAL ARSENICAL SPECIES,
Rutgers - The State Univ., New Brunswick, NJ. Dept. of Environmental Science.
S. D. Faust, A. Winka, T. Belton, and R. Tucker.
Journal of Environmental Sciences and Health, Vol. A18, No. 3, p 389-411, 1983. 3 Fig, 6 Tab, 10 Ref.

Descriptors: *Arsenic compounds, *Water pollution sources, Union Lake, New Jersey, Sediment contamination, Chemical analysis, Pore water, Monomethlyarsonic acid, Dimethlyarsinic acid, Industrial wastes.

The waters and bottom sediments in the watershed of Union Lake in southern New Jersey are highly contaminated with substantial quantities of arsenic. The single source of this contamination is an industrial manufacturer of arsenical compounds in the headwaters of this watershed. Total arsenic contents were as high as 2780 micro g/1 in the water phase, whereas 2290 micro g/1 was the highest observed in bottom sediments. Pore water from this bottom sediment was 12,500 micro g/1. Arsenic contents in the bottom sediments were 4240 times those found in overlying waters. In sediments, the order of predominance of the four arsenic species was: As(+5) > As(+3) > monomethylarsonic acid (MMAA) > dimethylarsinic acid (DMAA). In four of the sediments, the inorganic arsenate was 72.8, 81, 84, and 88% of the total arsenical species. In water, the order of predominance was MMAA > As(+3), As(+5) > DMAA. Difficulties with the analytical procedure for separation of the four arsenical species include erratic recoveries of the four arsenical species from the cation exchange column, and difficulties in the separation of As(+3) and As(+5). (Moore-IVI)
W84-01212

ASSESSMENT OF THE CHEMICAL AND BIOLOGICAL SIGNIFICANCE OF ARSENICAL COMPOUNDS IN A HEAVILY CONTAMINATED WATERSHED. PART I. THE FATE AND SPECIATION OF ARSENICAL COMPOUNDS IN AQUATIC ENVIRONMENTS - A LITERATURE REVIEW,
Rutgers - The State Univ., New Brunswick, NJ. Dept. of Environmental Science.
N. V. Lemmo, S. D. Faust, T. Belton, and R. Tucker.
Journal of Environmental Sciences and Health, Vol. A18, No. 3, p 335-387, 1983. 6 Fig, 8 Tab, 56 Ref.

Descriptors: *Arsenic, *Arsenic compounds, Chemical reactions, Fate of pollutants, Path of pollutants, Chemical analysis, Water pollution, Literature reviews.

The analysis for total arsenic is no longer sufficient to describe this contaminant in aquatic environments. Arsenic can undergo extensive chemical and biochemical transformations in an aquatic system. Since each of the resulting arsenic compounds differ in their toxicity to humans, it is important to follow these transformations. Examining the transformations under various chemical and physical conditions will aid in predicting the ultimate fate of the arsenicals in a given aquatic environment. In order to follow the transformations, it is first necessary to identify and quantitate them. It is important that the speciation procedures should be simple and adaptable to analyzing many samples. The review provides a summary of the chemistry of arsenite, arsenate, monomethylarsonic acid, and dimethylarsinic acid (cacodylic acid), their transformations in an aquatic environment, and a review of the methods developed to speciate these compounds. (Author's abstract)
W84-01213

GROUNDWATER FLOW AND IMPLICATIONS FOR GROUNDWATER CONTAMINATION NORTH OF PREWITT, NEW MEXICO, U.S.A.,
New Mexico Inst. of Mining and Technology, Socorro. Dept. of Geoscience.
For primary bibliographic entry see Field 2F.
W84-01215

LONGITUDINAL DISPERSION COEFFICIENTS FOR VARYING CHANNELS,
Cambridge Univ. (England). Dept. of Applied Mathematics and Theoretical Physics.
R. Smith.
Journal of Fluid Mechanics, Vol. 130, p 299-314, May, 1983. 5 Fig, 13 Ref.

Descriptors: *Path of pollutants, *Dispersion coefficient, *Flow characteristics, Mathematical models, Channel morphology, Water depth, Secondary flows, Upstream memory.

Although most flows in nature vary along their length, most theoretical work on longitudinal contaminant dispersion has concerned longitudinally uniform channels. It is justifiable to use such a uniform model only if the lengthscale for mixing across the channel is less than the lengthscale for channel variations. A general expression is obtained for the longitudinal dispersion coefficient for a passive contaminant in a varying channel. This expression reveals the upstream memory character of the dispersion coefficient. Simple examples are used to illustrate the effects of: a sudden change in breadth, centrifugally driven secondary flows, and changes in the depth profile. (Moore-IVI)
W84-01237

EFFECT OF LIMING AND LEACHING ON THE SULFUR-SUPPLYING CAPACITY OF SOILS,
International Fertilizer Development Center, Muscule Shoals, AL. Agro-Economic Div.
L. Korentajer, B. H. Byrnes, and D. T. Hellums.
Soil Science Society of America Journal, Vol. 47, No. 3, p 525-530, May-June, 1983. 2 Fig, 6 Tab, 31 Ref.

Descriptors: *Leaching, *Sulfur, *Liming effect, Fertility Gypsum, Percolation, Corn.

A greenhouse experiment was conducted to evaluate the effect of liming and subsequent percolation on SO4(--) leaching from two soils differing substantially in their native soil S status. Two crops of

corn (Zea mays L.) were then grown on the limed and leached soils with gypsum added in order to assess S crop response. With no liming, SO4(--) leaching losses in both soils were approximately 50% of those obtained at the highest liming rates. (2.0-2.5 g/kg); however, the effect varied depending on the soil S status. In the soil with the higher level of absorbed SO4(--) (35 micrograms/g of S), the leaching losses were more gradual, and SO4(--) elution followed a chromatographic pattern commonly observed with nonsorbing ions. Possible explanations for these patterns are presented. Crop production and S uptake, particularly by the second crop, reflected the significant effects of liming and leaching on the available S status of the soils. The results indicate that acid soils that are limed and subsequently leached may rapidly become S deficient and that the relative amounts of absorbed SO4(--) and mineralizable S are important factors in determining the magnitude of the liming effect. (Author's abstract)
W84-01258

IDENTIFICATION OF THE FLAME RETARDANT TETRABROMOBISPHENOL-A IN THE RIVER SEDIMENT, AND THE MUSSEL COLLECTED IN OSAKA,
Osaka Prefecture Inst. of Public Health (Japan).
I. Watanabe, T. Kashimoto, and R. Tatsukawa.
Bulletin of Environmental Contamination and Toxicology, Vol. 31, No. 1, p 48-52, July, 1983. 5 Fig, 7 Ref.

Descriptors: *Brominated hydrocarbons, *Flame retardants, *Water pollution, Mussels, Sediment contamination, Biodegradation, Chemical degradation, Phenols, Japan.

A river sediment was collected at Neya River, a tributary of the Yodo River, which empties into Osaka Bay, in September, 1981. Tetrabromobisphenol-A (TBBP) was identified in the river sediment, and the dimethyl ether deriviative of TBBP (TBBP-DM) was identified in the mussels. TBBP is known as a most suitable flame retardant for epoxy and polyester resins. The level of TBBP in the sediment was about 20 ppb on a dry weight basis. TBBP was not identified in the mussels, but TBBP-DM was found at about 5 ppb. This TBBP-DM might have been formed from TBBP by chemical or biological reactions in the environment, and subsequently accumulated in the mussels. (Moore-IVI)
W84-01294

FORMATION OF MUTAGEN BY PHOTOLYSIS OF AROMATIC COMPOUNDS IN WATER CONTAINING NITRITE ION,
Science Univ. of Tokyo. (Japan). Faculty of Pharmaceutical Sciences.
J. Suzuki, T. Hagino, T. Ueki, Y. Nishi, and S. Suzuki.
Bulletin of Environmental Contamination and Toxicology. Vol. 31, No. 1, p 79-84, July, 1983. 1 Fig, 2 Tab, 14 Ref.

Descriptors: *Mutagens, *Hydrocarbons, *Nitrites, *Photolysis, Aromatic compounds, Ultraviolet light, Water pollution, Benzenes.

Benzene, polycyclic aromatic hydrocarbons, and mono-substituted benzenes were irradiated for 3 hr with a 100 W high-pressure mercury lamp in aqueous nitrite solution. Ether extracts from the reaction mixtures were tested for mutagenicity using Salmonella typhimurium TA 98. The ether extracts of reaction mixtures of all compounds were mutagenic except for aniline and benzenesulfonate. When the light source was equipped with a Pyrex glass filter, most of the ether extracts were mutagenic except those from biphenyl, toluene, and benzenesulfonate. The wavelength characteristics of this light are analogous to sunlight. Based on this data, the formation of mutagens from organic compounds in aquatic environments is probably catalyzed by sunlight. (Moore-IVI)
W84-01295

FULVIC-ACID-ENHANCED BIODEGRADATION OF AQUATIC CONTAMINANTS,
National Water Research Inst., Burlington (Ontario).
D. Lui, J. Carey, and D. Thomson.
Bulletin of Environmental Contamination and Toxicology, Vol. 31, No. 2, p 203-207, August 1983. 2 Fig, 1 Tab, 10 Ref.

Descriptors: *Fate of pollutants, *Fulvic acid, *Humic acids, *Biodegradation, Thiazoles, Bacteria, Industrial wastes, Water pollution.

Humic substances are widely distributed in the enviroment and have been known to enhance the photochemical degradation of synthetic organics in the aquatic environment. Naturally occurring fulvic acid (FA) is found to enhance the biodegradation of synthetic organics in experiments using 2-(methlythio)benzothiazole (MMBT) as an model contaminant. The FA was extracted from water of the Grand River, Ontario. For use as the inoculum, a MMBT degrading bacterial culture was derived from the activated sludge of a sewage treatment plant receiving wastewater from a firm manufacturing chemicals for the rubber industry. The ability of FA to stimulate biodegradation was clearly demonstrated. MMBT was degraded faster in a fermentor containing FA (half-life 60 hr) than in one without FA addition (half-life 104 hr). Since a large portion of dissolved organic matter in fresh water is present as fulvic acid, this enhanced biodegradation may play an important role in determining the fate of aquatic contaminants. (Moore-IVI)
W84-01297

SULPHUR IN SEDIMENTS CHRONICLES PAST CHANGES IN LAKE ACIDIFICATION,
J. O. Nriagu, and R. D. Coker.
Nature, Vol. 303, No. 23, p 692-694, 23 June, 1983. 1 Fig, 1 Tab, 19 Ref.

Descriptors: *Sulfur, *Acid rain, *Sediments, Water pollution sources, Lake acidification, Sulfur isotopes, History, Ontario.

Sulfur pollution has closely been linked to the problems of acid precipitation and lake acidification. Although variations in sulfur isotypes can in principle be used to fingerprint the sources of sulfur in the lacustrine environment no attempt has so far been made to apply the technique in the study of pollutant sulfur in lakes in an historical sense. The concentrations and isotopic composition of sulfur in sediments of several softwater lakes of northern Ontario are reported. Lakes in the first group are located near Sudbury and are expected to derive most of their sulfur from the big nickel-copper smelter nearby. The second group of lakes are located in the more remote Algonquin Provincial Park with no know major local sources of sulfur. The sensitivity of the sediments to the influx of sulfur from local or distant sources is clearly demonstrated. (Moore-IVI)
W84-01301

BIOCONCENTRATION AND FIELD DISSIPATION OF THE AQUATIC HERBICIDE FLURIDONE AND ITS DEGRADATION PRODUCTS IN AQUATIC ENVIRONMENTS,
Lilly (Eli) and Co., Indianapolis, IN. Lilly Research Lab.
S. D. West, R. O. Burger, G. M. Poole, and D. H. Mowrey.
Journal of Agricultural and Food Chemistry, Vol. 31, No. 3, p 579-585, May/June, 1983. 12 Tab, 20 Ref.

Descriptors: *Biological magnification, *Fluridone, *Biodegradation, Herbicides, Fish, Pesticide residues, Aquatic environment, Hydrosoil, Aquatic weed control, Mathematical models.

The accumulation and dissipation patterns of the aquatic herbicide fluridone, 1-methyl-3-phenyl-5-(3-(trifluoromethyl)phenyl)-4(1H)-pyridinone, and its major degradation products have been determined in 40 pond and lake experiments in the United States, Panama, and Canada. The average bioconcentration factor for the total residue of fluridone plus a single major metabolite, 1-methyl-3-(4-hydroxyphenyl)-5-(3-trifluoromethyl)phenyl)-4(1H)-pyridinone, in several fish species was 1.33, 7.38, and 6.08 in edible tissue, inedible tissue, and whole body, respectively. Fluridone dissipated with an average half-life of 20 days in pond water and 3 months in pond hydrosoil. The treatment of small areas (0.8-4.0 ha) of large lakes resulted in more rapid dissipation due to dispersal of fluridone into the surrounding untreated water. Little or no carry-over of residues occurred prior to annual retreatments of the ponds. Mathematical models were evaluated for relating the half-life of fluridone in pond water to physical and chemical properties of the water. (Author's abstract)
W84-01304

BIOACCUMULATION OF ARSENIC BY FRESHWATER ALGAE AND THE APPLICATION TO THE REMOVAL OF INORGANIC ARSENIC FROM AN AQUEOUS PHASE. PART I. SCREENING OF FRESHWATER ALGAE HAVING HIGH RESISTANCE TO INORGANIC ARSENIC,
Kagoshima Univ. (Japan). Dept. of Applied Chemistry.
S. Maeda, T. Kumamoto, M. Yonemoto, S. Nakajima, and T. Takeshita.
Separation Science and Technology, Vol. 18, No. 4, p 375-385, 1983. 4 Fig, 4 Tab, 11 Ref.

Descriptors: *Algae, *Arsenic, *Fate of pollutants, *Bioaccumulation, Chlorella, Diatoms, Cyanophyta, Chlorophyta, Protozoa, Rotifers, Bacteria, Mine wastes, Geothermal power, Effluent.

Several freshwater alga having resistance to arsenic were screened from microorganisms which had been sampled at sites polluted with arsenic from a geothermal electric power plant and old mines and smelters and arsenic ores. The alga thus screened could grow in the liquid medium (Modified-Detmer culture medium) containing sodium arsenate at levels up to 2000 ppm as elemental arsenic concentration. Some mixed systems of alga grew rapidly in the media at the higher levels of arsenic ranging from 50 to 2000 ppm. The mixed systems of alga screened included predominantly blue-green algae, green algae, and diatoms, and also included protozoa, rotifera, and bacteria as minor components. One pure algal culture was obtained by means of an agar plate culture, and the algae isolated was identified as Chlorella vulgaris Beijerinck var. vulgaris. The growth of C. vulgaris in a pure culture was unaffected by 100 ppm of arsenic. (Author's abstract)
W84-01307

SEASONAL VARIATIONS OF CD, PB, CU AND NI LEVELS IN SNOW FROM THE EASTERN ARCTIC OCEAN,
Kernforschungsanlage Juelich G.m.b.H. (Germany, F.R.). Inst. fuer Chemie.
L. Mart.
Tellus, Vol. 35B, No. 2, p 131-141, April, 1983. 1 Fig, 8 Tab, 37 Ref.

Descriptors: *Snow, *Heavy metals, *Arctic, Lead, Cadmium, Copper, Nickel, Cobalt, Seasonal variation, Air pollution.

During the Swedish Arctic expedition 'Ymer 80' into the area from North Greenland to Franz-Josef-Land in late summer 1980, freshly fallen snow, and snow from the previous fall/winter season were collected from ice floes. Lead, cadmium and copper analysis was performed on board ship, using the advanced voltammetric determination method of differential pulse anodic stripping voltammetry at rotating glassy carbon electrodes. The analytic operations were performed under a clean bench in a clean room container. Nickel, and tentatively, cobalt levels were analyzed in the home laboratory by differential pulse voltammetry after preconcentration by chelate adsorption at a hanging mercury drop electrode. Results from freshly fallen snow compared to snow from the previous season show that there exists a strong seasonal variation in trace metal deposition, indicating that pollution of the Arctic atmosphere is clearly limited to winter time, when atmospheric conditions favor long-distance transport of polluted air masses from Europe to the Arctic. Unexpectedly low mean levels of 0.4 ng/kg Cd, 13 ng/

kg Pb, 20 ng/kg Cu and 22 ng/kg Ni were found in freshly fallen snow, levels that represent about 1/10 to 1/20 of those in annual condensed layers. (Author's abstract)
W84-01308

A NOTE ON FRACTURE FLOW DISPERSION MECHANISMS IN THE GROUND,
Royal Inst. of Tech., Stockholm (Sweden). Dept. of Chemical Engineering.
For primary bibliographic entry see Field 2F.
W84-01338

SIMULATION OF SOLUTE TRANSPORT IN A CHEMICALLY REACTIVE HETEROGENEOUS SYSTEM: MODEL DEVELOPMENT AND APPLICATION,
California Univ., Berkeley. Lawrence Berkeley Lab.
C. W. Miller, and L. V. Benson.
Water Resources Research, Vol. 19, No. 2, p 381-391, April, 1983. 8 Fig, 2 Tab, 24 Ref. DEAC03-76SF00098, DOE 50-80-97.

Descriptors: *Solute transport, *Route of pollutants, Advection, Diffusion, Mathematical models, Ion exchange, Mass action, Water dissociation, Strontium, Groundwater pollution, Aqueous complexation.

One-dimensional transport of solutes in a saturated porous medium has been simulated using a numerical model CHEMTRN. This model includes dispersion/diffusion, advection, ion exchange, formation of complexes in the aqueous phase, and the dissociation of water. The mass action, transport, and site constraint equations are expressed in a differential/algebraic form and solved simultaneously. In the mass action equations describing complexation and sorption processes, the activities of the species in the aqueous phase are approximated using the Davies equation. A solubility constraint can be set at the inner boundary. The model was applied to a study of the migration of strontium in groundwater. Results show that surface site competition is important when the strontium concentration is comparable to the background electrolyte concentration, in which case a constant k sub D model does not simulate the transport of chemical species adequately. In addition, the pH level was buffered to a level of approximately 10 near the wasteform due to the incorporation of the solubility constraint. For the particular case studied, the incorporation of aqueous complexation did not significantly enhance strontium mobility. (Author's abstract)
W84-01340

COMBINED MIXING CELL/ANALYTICAL MODEL TO DESCRIBE TWO-DIMENSIONAL REACTIVE SOLUTE TRANSPORT FOR UNIDIRECTIONAL GROUNDWATER FLOW,
Kiel Univ. (Germany, F.R.). Geologisch-Palaeontologisches Inst. und Museum.
H. D. Schulz, and E. J. Reardon.
Water Resources Research, Vol. 19, No. 2, p 493-502, April, 1983. 7 Fig, 1 Tab, 8 Ref.

Descriptors: *Groundwater movement, *Solute transport, Mathematical models, Mixing, Ion exchange, Chemical precipitation, Advection, Dispersion, Calcite, Path of pollutants.

A combined two-dimensional mixing cell/analytical solution is presented which describes multiple reactive solute transport in unidirectional groundwater flow regimes. The model uses a two-step solving routine which separates chemical equilibria computations (ion exchange and mineral precipitation/ dissolution) from calculations of advection/ dispersion. Before running the model for a particular grid configuration, an isochemical flow situation is run first to calibrate the model. The calibration technique adjusts for mass losses or gains to and from cells, which occurs when using mixing cell models. Computational time for calculating chemical equilibria in each mixing cell is markedly reduced by the use of a single-equation solution to solve for multi-ion exchange equilibria and a rapid iterative technique to solve for calcite equilibria. The application of the model to simulate a solution injection experiment into an unconsolidated sand deposit yielded results in reasonable agreement with field observations. (Author's abstract)
W84-01351

EFFECTS OF LIGHT AND THE IMPORTANCE OF LIVING PLANT TISSUES ON THE FATE OF (14C)PHORATE IN WATER AND ELODEA PLANTS,
Wisconsin Univ.-Madison. Dept. of Entomology.
G. Walter-Echols, and E. P. Lichtenstein.
Journal of Agricultural and Food Chemistry, Vol. 31, No. 3, p 637-641, May/June, 1983. 4 Fig, 1 Tab, 11 Ref.

Descriptors: *Pesticide residues, *Light effects, *Elodea, Vegetation, Plant physiology, Carbon radioisotopes, Insecticides, Metabolism, Water pollution effects.

The importance of living plant tissues and light on the uptake and metabolism of C-14 phorate-derived residues from water by Elodea nuttallii plants was investigated. Plants growing for 2 weeks in water with a bottom deposit of C-14 phorate-treated soil accumulated in their tissues up to 30% of the originally soil-applied radiocarbon and 56% when the insecticide had been directly applied to the water. Most of the C-14 labeled compounds thus taken up were bound to plant tissues, which might explain the small amounts of radiocarbon released later from these plants into insecticide-free water. The uptake of insecticides from water was a function of the living plant, since dead plant tissues contained only small amounts (2.6% of that found in living plants) of C-14 labeled compounds after having been exposed for 72 h to C-14 phorate-contaminated water. Moreover, most of the C-14 phorate-derived compounds (38.4% of applied) were taken up by Elodea plants when exposed to light, while plants incubated in the dark contained only 9% of the radiocarbon originally applied to the water. (Author's abstract)
W84-01371

STUDIES ON THE BEHAVIOUR OF NUTRIENTS IN THE MANDOVI ESTUARY DURING PREMONSOON,
National Inst. of Oceanography, Panaji (India).
For primary bibliographic entry see Field 2L.
W84-01385

BEHAVIOUR OF COPPER, ZINC, IRON AND MANGANESE DURING EXPERIMENTAL RESUSPENSION AND REOXIDATION OF POLLUTED ANOXIC SEDIMENTS,
Lancaster Univ., Bailrigg (England). Dept. of Environmental Sciences.
J. M. Hirst, and S. R. Aston.
Journal of Estuarine, Coastal and Shelf Science, Vol. 16, No. 5, p 549-558, May, 1983. 3 Fig, 4 Tab, 11 Ref.

Descriptors: *Suspended sediments, *Estuarine environment, *Water pollution, *Metals, Resuspension, Oxidation, Copper, Zinc, Iron, Manganese, Water temperature, Salinity, Hydrogen ion concentration, Oxygen concentration, Path of pollutants.

Samples of anoxic intertidal sediments from the Mersey Estuary, north-west England, have been used in laboratory experiments to determine the rates and extents of metal (Cu, Zn, Fe, Mn) releases to solution under conditions of controlled resuspension and reoxidation. An experimental system for the study of sediment-water interactions at various temperatures, salinities, pHs and oxygen concentrations is described. The results indicate rapid initial losses of Fe and Mn from sediment but not Cu and Zn with longer term readsorption of Fe and Mn to give partitioning between the aqueous/sediment phases for all four metals which is similar to that under the initial anoxic conditions. Cu and Zn show small, but measurable, net losses from the aqueous phase to the reoxidized sediment. Salinity variations exert little influence on the processes observed, but increasing temperature produces increased Cu, Zn and Mn in the dissolved fraction at equilibrium conditions. Exchanges of Cu and Zn between the sediment/water phases are rather insensitive to pH or oxygen concentrations, but Fe and Mn do respond to increasing pH which suppress their initial release on oxidation. Low oxygen concentrations can result in a slow but significant release of Fe. In relation to trace metal pollution in estuaries and biological availability, the results suggest that the resuspension and oxidation of polluted anoxic sediments is not an important process because of scavenging of soluble metals on to the resuspended material. (Author's abstract)
W84-01396

5C. Effects Of Pollution

OCCURRENCE AND PATHOGENICITY OF NAEGLERIA FOWLERI IN ARTIFICIALLY HEATED WATERS,
Pittsburgh Univ., PA. Graduate School of Public Health.
J. L. Sykora, G. Keleti, and A. J. Martinez.
Applied and Environmental Microbiology, Vol. 45, No. 3, p 974-979, March 1983. 1 Fig, 4 Tab, 12 Ref.

Descriptors: *Thermal pollution, *Pathogenic protozoa, *Cooling water, *Naegleria fowleri, *Pennsylvania, Protozoa, Pathogens, Powerplants, Hydrogen ion concentration, Cooling towers.

The occurrence of pathogenic N. fowleri in thermal discharges, recipient waters, and cooling towers of eight power plants located in western Pennsylvania was investigated for 2 yr in conjunction with several environmental measurements. Pathogenic N. fowleri was detected in one cooling tower and in the discharge, receiving waters, or both of five of eight localities. The occurrence of this organism was related to elevated temperatures, but no significant correlation was found for other biological and chemical parameters. Laboratory experiments on the effect of pH on pathogenic N. fowleri documented 100% survival at a range from 2.1 to 8.15. Higher pH reduced or killed the amoebae. No case of human primary amoebic meningoencephalitis occurred. (Author's abstract)
W84-01055

SURVIVAL OF NATURAL SEWAGE POPULATIONS OF ENTERIC BACTERIA IN DIFFUSION AND BATCH CHAMBERS IN THE MARINE ENVIRONMENT,
Rhode Island Univ., Kingston. Dept. of Microbiology.
E. J. Lessard, and J. M. Sieburth.
Applied and Environmental Microbiology, Vol. 45, No. 3, p 950-959, March 1983. 6 Fig, 1 Tab, 44 Ref. EPA grants R804866010 and R804866012, NSF grant OCE-7681779.

Descriptors: *Escherichia coli, *Estuarine environment, *Salt marshes, *Enteric bacteria, Sewage bacteria, Wastewater pollution, Temperature effects, Light effects, Rhode Island, Narragansett Bay, Bisset Cove.

The survival of natural populations of Escherichia coli and enterococci in sewage was measured in large-volume diffusion chambers in an estuary and a salt marsh. The 5-liter chambers, with polycarbonate membrane sidewalls, were found to be suitable for up to week-long experiments. Decay rates, measured monthly from February to August 1978, ranged from 0.042 to 0.088/hr (time for 90% of the population to die = 25 to 55 hr) for E. coli and 0.019 to 0.083/hr (time for 90% of the population to die = 29 to 122 hr) for enterococci and were significantly correlated with temperature. In contrast to the diffusion culture experiments, the decay of E. coli in batch culture did not correlate with temperature. Enterococci survived longer than E. coli in the Narragansett Bay (estuary) experiments, but survived less well in the more eutrophic salt marsh. The effect of light on survival was examined with light/dark experiments and sampling at frequent intervals over the diel cycle. Diel changes in survival were not evident in the Narragansett Bay experiments. E. coli, however,

exhibited a diel pattern of growth during the day and death at night in the salt marsh. There was no significant difference in decay rates between light and dark diffusion chambers, nor were decay rates correlated with light intensity. In concurrent batch experiments, survival was significantly greater in the dark for both organisms. These results suggest that the effect of light is complex and that conditions in batch culture may modify the survival of enteric bacteria. Observations made in diffusion chambers may more closely follow the in situ survival of enteric microorganisms. (Author's abstract)
W84-01056

MOUNT ST. HELENS ERUPTIVE IMPACTS TO THE TOUTLE COMMUNITY GROUNDWATER SUPPLY,
Sweet, Edwards and Associates, Inc., Kelso, WA.
For primary bibliographic entry see Field 5F.
W84-01058

INTERLABORATORY STUDY ON DETERMINATION OF 2,3,7,8-TETRACHLORODIBENZO-P-DIOXIN IN FISH,
Health and Welfare Canada, Ottawa (Ontario). Health Protection Branch.
For primary bibliographic entry see Field 5A.
W84-01062

EFFECT OF PHENOL MOLECULAR STRUCTURE ON BACTERIAL TRANSFORMATION RATE CONSTANTS IN POND AND RIVER SAMPLES,
Environmental Protection Agency, Athens, GA.
D. F. Paris, N. L. Wolfe, W. C. Steen, and G. L. Baughman.
Applied and Environmental Microbiology, Vol. 45, No. 3, p 1153-1155, March, 1983. 1 Fig, 2 Tab, 12 Ref.

Descriptors: *Phenols, *Microbial degradation, *Molecular structure, Bacteria, Substituted phenols, Pollutants, Microbial rate constants.

Microbial transformation rate constants for a series of phenols were correlated with a property of the substituents, van der Waal's radius. The compounds used were phenol, p-methylphenol, p-methoxyphenol, p-chlorophenol, p-bromophenol, p-acetylphenol, p-cyanophenol, and p-nitrophenol. Water samples collected from five sites within 10 km of Athens, Georgia, were used in order to extend previous studies to mixed populations from natural waters. Transformation products were the corresponding catechols, with the exception of p-hydroxybenzoic acid, the product of p-acetylphenol. A different product suggested a different pathway; p-acetylphenol, therefore, was deleted from the data base. (Moore-IVI)
W84-01090

TOXIC EFFECTS OF TWO ORGANOPHOSPHORUS PESTICIDES ON FRUCTOSE-1,6-DIPHOSPHATE ALDOLASE ACTIVITY OF LIVER, BRAIN AND GILLS OF THE FRESHWATER FISH CLARIAS BATRACHUS,
Lucknow Univ. (India). Dept. of Zoology.
R. S. Tandon, and A. Dubey.
Environmental Pollution (Series A), Vol. 31, No. 1, p 1-7, May, 1983. 2 Tab, 17 Ref.

Descriptors: *Organophosphorus pesticides, *Toxicity, *Enzymes, *Clarias batrachus, Aldolase, Malathion, Dimecron, Water pollution effects, Fish.

The overuse of pesticides and other chemical in some agricultural and public health operations sometimes adversely affects non-target organisms such as freshwater fish. The activity of different enzymes in the body may be altered, and finally death occurs. Exposure to different concentrations of two organophosphorus pesticides, malathion (4.80-6.20 ppm) and dimecron (2.50-6.00 ppm), in water produced elevated aldolase activity in the liver, brain and gill tissues of the freshwater fish Clarias batrachus, exposed for periods of 24 to 96 hr. The toxic conditions produced by the pesticide ultimately caused the death of the fish owing to the failure of the respiratory center of the brain. The breakdown of proteins and the diabetic condition caused by the organophosphorus pesticide toxicity appeared to be the possible cause of increased aldolase activity. (Moore-IVI)
W84-01113

ENUMERATION AND CHARACTERIZATION OF BACTERIA INDIGENOUS TO A SHALLOW WATER-TABLE AQUIFER,
Robert S. Kerr Environmental Research Lab., Ada, OK.
For primary bibliographic entry see Field 5B.
W84-01123

PHYSIOLOGICAL CHANGES IN CARPS INDUCED BY POLLUTION,
Karlsruhe Univ. (Germany, F.R.). Dept. of Zoology II.
W. Hanke, G. Gluth, H. Bubel, and R. Muller.
Ecotoxicology and Environmental Safety, Vol. 7, No. 2, p 229-241, April, 1983. 9 Fig, 27 Ref.

Descriptors: *Pesticides, *Carp, *Toxicity, *Bioassay, *Enzymes, Indicators, Bioindicators, Cortisol, Glucose, Glycogen, Atrizine, Insecticides, Fungicides, Herbicides.

Physiological changes in carp were evaluated for use as indicators of pollutants in environmental water systems. The pesticide DDT, the herbicide atrazine, the fungicides PCP and HCB, and the insecticides dieldrin, lindane and aldrin were used as test pollutants. The pollutants induce changes in cortisol and glucose levels in serum, variations in the amount of liver glycogen and liver function, changes in gill ATPase and brain and serum acetylcholinesterase of carp. There is always a biphasic response, with an increase in the concentration or enzyme activity for a short time, and a decrease or inhibition of the enzymes after a longer exposure to the pollutants. The time scale (the duration of the periods of increase and decrease) depends on the concentration and toxicity of the pollutants. Comparison of carp in fresh water and carp acclimated to 1.2% salt water indicates that there is greater sensitive to the pollutants under the influence of salt water. All responses are unspecific. Suggestions are given for the use of these tests as criteria for water quality. (Moore-IVI)
W84-01129

EFFECTS OF TEMPERATURE AND COLOR COMPONENTS OF WASTEWATER DISCHARGES ON AQUATIC COMMUNITIES,
Westvaco Corp., Covington, VA.
T. G. Botkins, Jr.
Tappi Journal, Vol. 66, No. 3, p 107-110, March, 1983. 5 Fig, 1 Tab.

Descriptors: *Thermal pollution, *Color, *Pulp wastes, Water pollution effects, Effluents, Industrial wastes, Aquatic life, Simulation, Model studies, Cooling water, Stream discharge, Fish, Bass, Jackson River, Virginia.

Westvaco operates a bleached kraft and semi-chemical pulp and paper mill and an activated carbon plant in Covington, Virginia. Process and cooling-water effluents from the facility are discharged into the Jackson River. A thermal discharge demonstration was conducted to evaluate the effects of temperature and color components of the discharges on aquatic communities. The study included: modeling to simulate stream flows and temperatures, an evaluation of the thermal tolerance limits of fish and supportive tropic levels, and the execution of bioassays to assess the joint effect of temperature and color on smallmouth bass. It was concluded that mill effluents would not cause an imbalance of the indigenous aquatic communities. (Moore-IVI)
W84-01164

SORPTION OF POLYCHLORINATED BIPHENYLS (PCB) TO CLAY PARTICULATES AND EFFECTS OF DESORPTION ON PHYTOPLANKTON,
State Univ. of New York at Stony Brook. Marine Sciences Research Center.
G. M. Nau-Ritter, and C. F. Wurster.
Water Research, Vol. 17, No. 4. p 383-387, April, 1983. 5 Fig, 1 Tab, 27 Ref.

Descriptors: *Polychlorinated biphenyls, *Clays, *Sorption, *Phytoplankton, Illite, Chlorite, Water pollution effects.

The sorption of polychlorinated biphenyls (PCB) on illite and chlorite, two minerals of defined comparison, was investigated. Illite particles adsorbed higher C-14 PCB (Aroclor 1254) concentrations than did chlorite particles with equilibrium concentration factors between particles and water being 1.4 x 0.0001 for illite and 1.0 x 0.0001 for chlorite. Desorbed PCB inhibited photosynthesis and reduced chlorophyll-a content of natural phytoplankton assemblages within dialysis membrane bags suspended in the water of a tidal marsh. There was no significant difference in effects on the phytoplankton of PCB desorbed from the two minerals. The rate of C-14 PCB desorption was dependent on the initial concentration on the clay particles. The rate of C-14 PCB loss from bags with particles was slower than that from bags without particles. (Author's abstract)
W84-01262

THE INFLUENCE OF SPRING AND FALL TEMPERATURES ON THE AVOIDANCE RESPONSE OF JUVENILE ATLANTIC MENHADEN, BREVOORTIA TYRANNUS, EXPOSED TO SIMULTANEOUS CHLORINE-DELTA T CONDITIONS,
Johns Hopkins Univ., Laurel, MD. Applied Physics Lab.
L. W. Hall Jr., D. T. Burton, S. T. Margrey, and W. C. Graves.
Water Resources Bulletin, Vol. 19, No. 2, p 283-287, April, 1983. 2 Fig, 2 Tab, 25 Ref.

Descriptors: *Power plants, *Menhaden, *Chlorine, *Temperature effects, Fish behavior, Avoidance, Environmental effects, Chlorination, Cooling water, Effluent, Residual chlorine, Acclimation.

The avoidance response of groups of juvenile Atlantic menhaden, Brevoortia tyrannus, was evaluated by exposing test species to a range of simultaneous total residual chlorine (TRC) (0.00, 0.05, 0.10, and 0.15 mg/L) and elevated temperature (0, 2, 4, and 6 C) conditions simulating power plant discharges. This species was tested at both 15 and 20 C to determine possible effects of acclimation temperature on the avoidance response. These temperatures were selected to represent spring or fall thermal conditions when most East Coast power plant facilities initiate power plant chlorination in the spring or terminate the use of this biocide in the fall. An unbalanced 3-factor factorial design was used to develop response surface avoidance models at 15 and 20 C. The model developed at 15 C showed: (1) an increase in avoidance occurred at all delta T conditions as TRC increased from 0.00 to 0.05 mg/L; (2) a greater degree of avoidance occurred at TRC concentrations above 0.05 mg/L at all delta T conditions; and (3) TRC was the most important term influencing avoidance. There was a significant difference ($p<0.00001$) between avoidance models at 15 and 20 C. However, when extreme conditions of 0.15 mg/L TRC and 0-6 C T were compared, the degree of avoidance responses (percent time in control area) was similar. (Author's abstract)
W84-01275

DISSIPATION OF 2,4-D DMA AND BEE FROM WATER, MUD AND FISH AT LAKE SEMINOLE, GEORGIA,
Army Engineer Waterways Experiment Station, Vicksburg, MS. Environmental Lab.
R. E. Hoeppel, and H. E. Westerdahl.
Water Resources Bulletin, Vol. 19, No. 2, p 197-204, April, 1983. 2 Fig, 2 Tab, 42 Ref.

Descriptors: *Dissolved oxygen, *Herbicides, *Water pollution effects, Pesticides, Acidity, Lakes, 2,4-D, Lake Seminole, Georgia, Myriophyllum.

Dense watermilfoil beds of Lake Seminole, Georgia were treated with either 2,4-D dimethylamine (DMA) or 2,4-D bisoxyethanol ester (BEE) at rates of 22.5 and 45 kg a.e./ha. Rapid conversion of both formulations to the 2,4-D acid form was observed with no detection of either original compound in the water in less than 24 hrs after application. Maximum detected 2,4-D concentrations in the high rate, 2,4-D DMA and 2,4-D BEE plots were 3.6 and 0.68 mg/l, respectively. All but seven samples at a 2,4-D BEE plot showed non-detectable herbicide levels after 6 days and all water samples were below detectable limits by day 13. Potentially toxic transformation products such as dimethylnitrosamine and 2,4-dichlorophenol were not detected. No significant accumulation of 2,4-D was found in fish collected from sites treated with 2,4-D DMA. Sedimentation showed no significant accumulation of 2,4-D, 2,4-D BEE or 2,4-dichlorophenol. Small decreases in dissolved oxygen and pH, associated with the complete watermilfoil control in plots had returned to normal summer values by day 28. (Baker-IVI)
W84-01287

TOTAL MERCURY IN FISHES AND SELECTED BIOTA IN LAHONTAN RESERVOIR, NEVADA: 1981,
Nevada Univ. System, Reno. Bioresources Center.
J. J. Cooper.
Bulletin of Environmental Contamination and Toxicology, Vol. 31, No. 1, p 9-17, July, 1983. 3 Tab, 27 Ref. 14-34-0001-0271.

Descriptors: *Mercury, *Fish, *Biological magnification, Water pollution effects, Industrial wastes, Heavy metals, Bioaccumulation, Lahontan Reservoir, Nevada.

Lahontan Reservoir, located 72 km southeast of Reno, Nevada, receives the entire flow of the Carson River. Mercury was introduced into the Carson River during the mining of gold and silver in the Comstock Lode. During the summer of 1981 fish were collected for analysis using a variety of methods including gill netting, beach seining and dip netting. Results of cold vapor atomic absorption analysis indicate that significant mercury accumulation is occurring within fishes of Lahotan Reservoir. Mercury concentrations in muscle tissue collected from 11 species ranged from 0.11 mg/kg in young-of-the-year white bass to 9.52 mg/kg in a striped bass with a know residence time within the waterbody of 16 yr. Of 53 muscle tissue samples analyzed, 36 (68%) exceeded the 1 mg/kg action level. In general, mercury concentrations within species increased with fish weight. A significant difference was found between mean mercury concentration in omnivores (1.16 mg/kg) compared to second order piscivores (1.64 mg/kg) ($P<0.05$). Likewise, mean mercury concentrations of the second order piscivores were significantly lower than first order piscivores (3.39 mg/kg) ($P<0.001$). This suggests that biomagnification is occurring within the fishes of Lahontan Reservoir. (Moore-IVI)
W84-01292

EFFECTS OF TEMEPHOS ON THE RESPIRATORY RATE OF THE SALT MARSH AMPHIPOD, GAMMARUS MUCRONATUS,
Northeastern Univ., Boston, MA. Dept. of Biology.
E. Ruber, and K. LaFrance.
Bulletin of Enviromental Contamination and Toxicology, Vol. 31, No. 2, p 148-151, August, 1983. 1 Fig, 2 Tab, 6 Ref. RR07143.

Descriptors: *Toxicity, *Insecticides, Temephos, Amphipods, Environmental effects, Aquatic animals.

In order to determine whether overall changes in metabolic rate of amphipods can be detected at sublethal concentrations of insecticides and whether this could lead to predictions of mortality after 48-hr or longer, the amphipod Gammarus mucronatus was exposed to the organophosphate temephos. After exposure, the gammarids were removed to vials where oxygen concentration changes over 4-hr were measured. The reduction in oxygen concentration after exposure to 0.01 ppm temephos is not statistically significant, but the reduction after exposure to 0.1 ppm is. This shows significant respiratory inhibition at 24-hr at concentrations of insecticide which do not cause significant 24-hr mortality rates. With further refinements, this technique may be useful for impact analysis. (Moore-IVI)
W84-01296

CONCENTRATIONS OF UNSUBSTITUTED POLYCYCLIC AROMATIC HYDROCARBONS IN SOFTSHELL CLAMS FROM COOS BAY, OREGON, USA,
Oregon State Univ., Corvallis. Dept. of General Science.
M. C. Mix, and R. L. Schaffer.
Marine Pollution Bulletin, Vol. 14, No. 3, p 94-97, March, 1983. 2 Tab, 1 Fig. CR 808000-01-0.

Descriptors: *Polycyclic aromatic hydrocarbons, *Benzo(a)pyrene, *Clams, Monitoring, Water pollution, Estuaries, Hydrocarbons, Industrial plants, Bays, Oregon.

Concentrations of benzo(a)pyrene (BAP) were measured in subpopulations of softshell clams, Mya arenaria, from four intertidal sites in Coos Bay from June 1976 to June 1978. Subsequently, concentrations of 15 unsubstituted polynuclear aromatic hydrocarbons (PNAH) were determined in two subpopulations from September 1978 to August 1979. There were significant differences between BAP concentrations in clams from the four sites. For the two-year period, they were highest in clams inhabiting areas adjacent to the industrialized bayfront and lowest in clams inhabiting more remote areas. There were no significant seasonal variations in BAP concentrations during this period. During the 1978-79 study, the average total PNAH concentration in clams from the bayfront area was 555.1 microgram/kg compared to 76.3 microgram/kg for clams from a more remote environment. In general, PNAH concentrations were lowest in the fall-winter and highest during the spring-summer. It appears that the use of clams as indigenous monitors has significant merit, particularly in bays such as those in Oregon which are fresh-water dominated for extended periods of the year. The BAP and PNAH levels in clams from the four sites reflected the degree of development and industrialization and presumably, the level of contamination in the overlying water column. (Moore-IVI)
W84-01368

UPTAKE OF LEAD AND CHROMIUM BY PRIMARY PRODUCERS AND CONSUMERS IN A POLLUTED LAGOON,
Cagliari Univ. (Italy). Dept. of Pharmaceutical Chemistry and Toxicology.
W. Capone, C. Mascia, M. Porcu, and M. L. Tagliasacchi Masala.
Marine Pollution Bulletin, Vol. 14, No. 3, p 97-102, March, 1983. 3 Fig, 10 Tab, 6 Ref.

Descriptors: *Bioaccumulation, *Industrial wastes, *Lagoons, Water pollution effects, Petrochemicals, Oil industry, Crustaceans, Trophic levels, Sediments, Sardinia, Lead, Chromium.

Sediments, aquatic macrophytes and some species of crustacea taken from the S. Gilla lagoon in Sardinia were analyzed for possible concentrations of lead and chromium resulting from exposure to wastewater from urban centers and industrial plants and pollution from a nearby petrochemical plant. Among the Thallophyta tested, the highest values of bioaccumulation were found in Polysiphonia, which were totally absent from some sampling sites. In the Ruppia type a lead higher accumulation was noted in the radical apparatus and for chromium in the foliar one. The values of foliar bioconcentration for both metals do not change greatly with changes in the concentrations in the sediments. Among the Crustacea considered, the order of decreasing importance concerning bioconcentration for chromium and lead is Corpophium, Sphaeroma, Gammarus, and Idothea. The total lagoon mean values of transfer factors between the various crustacea and the seaweed which they usually consume show a tendency to accumulate more chromium than lead. The exception in the case of Sphaeroma could be explained by the higher weight in its exoskeleton due to the calcium content. (Baker-IVI)
W84-01369

MINE-DERIVED METAL POLLUTION IN THE ISLE OF MAN,
Liverpool Univ., Port Erin (England). Dept. of Marine Biology.
T. Southgate, D. J. Slinn, and J. F. Eastham.
Marine Pollution Bulletin, Vol. 14, No. 4, p 137-140, April, 1983. 4 Fig, 3 Tab, 20 Ref.

Descriptors: *Mollusks, *Mine drainage, *Estuaries, Zinc, Lead, Copper, Cadmium, Sediments, Bioaccumulation, Mytilus, Scrobicularia, Heavy metals, Harbors, Isle of Man.

The sediments of rivers draining areas of past mining activity in the Isle of Man contained greatly enhanced levels of zinc, lead and, to a lesser extent, copper and cadmium. This contamination extended into the estuarine harbors where it was reflected in the metal content of four species of bivalve mollusks. Of the latter, Mytilus edulis was the most useful indicator species in that it occurred in all five estuarine harbors but Scrobicularia plana, although of more limited distribution, concentrated much higher levels of zinc and lead. Individual variation of metal levels was high in all species of bivalves examined; a negative correlation of dry weight:metal content was demonstrated in many cases, but other factors may also contribute to such variation. (Author's abstract)
W84-01370

EFFECTS OF LARGE FRESHWATER DIVERSIONS ON BENTHOS OF A MEDITERRANEAN LAGOON,
Endoume Marine Station and Oceanography Centre, Marseille (France).
G. Stora, and A. Arnoux.
Estuaries, Vol. 6, No. 2, p 115-125, June, 1983. 6 Fig, 2 Tab, 15 Ref.

Descriptors: *Estuarine environment, *Water diversion, *Salinity, Hydroelectric plants, Oxygen depletion, Sedimentation, Mollusks, Lagoons, Benthos, Marine animals, Etang de Berre, France.

The Etang de Berre, located near Marseille, is the largest French Mediterranean lagoon. Studies before and after commencement of operation of a hydroelectric plant have followed changes in marine benthic communities in response to erratic freshwater inflows diverted from the Durance River. After several unstable years, the marine benthic communities were replaced by a euryhaline and eurythermal assemblage and large areas of the lagoon were devoid of macrobenthos due to oxygen depletion. Analysis of the dynamics of mollusk populations shows the importance of fluctuations in freshwater discharges and resulting salinity variation, sedimentation, dissolved oxygen depletion and sediment pollutants. (Author's abstract)
W84-01377

INDEX ASSOCIATED WITH NUTRIENT EUTROPHICATION IN THE MARINE ENVIRONMENT,
Democritus Nuclear Research Center, Athens (Greece).
M. Karydis, L. Ignatiades, and N. Moschopoulou.
Estuarine, Coastal and Shelf Science, Vol. 16, No. 3, p 339-344, March, 1983. 3 Fig, 3 Tab, 12 Ref.

Descriptors: *Eutrophication, *Marine environment, *Nutrients, Phosphorus, Nitrogen, Effluents, Wastewater pollution, Bays, Gulfs, Saronicos Gulf.

The annual loadings and distributional patterns of phosphorus and nitrogen were observed at several stations in the Saronicos Gulf, Aegean Sea during 1980. All nutrient concentrations peaked sharply in the northern part of the gulf where a sewage outfalls exists. A nutrient eutrophication index was devised with the following criteria: to be specific

for each nutrient; to take into account loading of the area by the nutrient; to be dimensionless and have application to various types of water; to be sensitive to stressful effects of eutrophication; and to be simple for gathering data and for calculation. The nutrient eutrophication index (I) offers a rigorous test of the degree of eutrophication at the stations on the Saronicos Gulf. The sensitivity of the index implies that it can be used in most gulfs and embayments enriched by sewage discharges and characterized by strong environmental gradients. (Moore-IVI)
W84-01388

OXYGEN CONSUMPTION IN THE SHRIMP, PALAEMONETES PUGIO, EXPOSED TO FLUCTUATING TEMPERATURES AND FOOD CONTAMINATED WITH THE DIAROMATIC PETROLEUM HYDROCARBON, DIMETHYLNAPHTHALENE,
Virginia Inst. of Marine Science, Gloucester Point.
T. M. Dillon.
Estuarine, Coastal and Shelf Science, Vol. 16, No. 4, p 403-413, April, 1983. 4 Fig, 1 Tab, 36 Ref. NA81AA-D-00025, NA80AA-D-00021.

Descriptors: *Dimethylnaphthalene, *Toxicity, *Shrimp, *Oxygen requirements, Water temperature, Hydrocarbons, Oxygen concentration.

Oxygen consumption rates (VO2) in the grass shrimp Palaemonetes pugio were determined after a 32 day exposure to fluctuating temperatures (FT) (18-22 C) and/or dimethylnaphthalene (DMN)-contaminated food (0.24 micro g DMN/g wet wt) and again after a 16 day recovery period of stable temperatures (20 C) and uncontaminated food. Ingestion of DMN-contaminated food for 32 days resulted in elevated VO2 in shrimp exposed to declining oxygen concentrations. After the 32 day exposure period, FT had no significant effect on VO2 at 15, 20 and 25 C, tissue VO2 and VO2 in declining oxygen. Hemolymph copper concentrations were significantly depressed in shrimp exposed to DMN-contaminated food. After the 16 day recovery period, shrimp from the FT regime exhibited depressed VO2 when exposed to 25 C but not to 15 C. These depressed respiratory rates were offset by the stimulatory effect of DMN-contaminated food. These respiration studies were generally unproductive in explaining the previously reported effects of FT and DMN-contaminated food on the survival of P. pugio under hypoxic conditions. (Author's abstract)
W84-01390

5D. Waste Treatment Processes

BIOASSAY AND DOSE MEASUREMENT IN UV DISINFECTION,
North Carolina Univ. at Chapel Hill. Dept. of Environmental Sciences and Engineering.
R. G. Qualls, and J. D. Johnson.
Applied and Environmental Microbiology, Vol. 45, No. 3, p 872-877, March, 1983. 6 Fig, 20 Ref.

Descriptors: *Bioassay, *Disinfection, *Ultraviolet radiation, *Wastewater treatment, Bacillus, Spores, Flow-through reactors, Multiple-lamp reactors, Bacteria.

Comparison between various pilot and full-scale investigations of ultraviolet (UV) disinfections of wastewater has been limited because there was no direct method of measuring UV doses nor any substantiated method for calculating doses in the complex geometries and absorbing solutions within practical reactors. A bioassay method was developed to measure the average intensity within a UV disinfection reactor. The survival of spores of Bacillus subtilis was determined as a function of UV dose to prepare a standard curve. Spores were added to unknown systems, and the survival rate was used to determine the average intensity. A modification was used for flow-through reactors by which spores were injected as a spike and collected at a known time after injection. A point source summation method for calculating intensity was verified by bioassay measurements in a simple cylinder. This method was also applied to multiple-lamp reactors. (Moore-IVI)
W84-01051

INFLUENCE OF SUBSTRATUM WETTABILITY ON ATTACHMENT OF FRESHWATER BACTERIA TO SOLID SURFACES,
Warwick Univ., Coventry (England). Dept. of Environmental Sciences.
J. H. Pringle, and M. Fletcher.
Applied and Environmental Microbiology, Vol. 45, No. 3, p 811-817, March 1983. 4 Fig, 3 Tab, 37 Ref.

Descriptors: *Bacteria, *Substrates, *Wettability, *Deterioration, Corrosion, Clogging, Adhesion, Wastewater treatment.

Attachment of bacteria to surfaces of flowing systems such as pipelines ensures that the population is not eliminated by washout and may be the first stage in the deterioration of such structures through corrosion or clogging. Bacterial adhesion and growth on various substrata can have advantages in biotechnological processes such as waste treatment. The attachment of a number of freshwater bacteria from River Sowe, Coventry, England, to hydrophobic and hydrophilic surfaces was evaluated, and further studies evaluated the attachment of selected isolates to a number of substrata with a range of water wettabilities. The wettability of each substratum was determined by contact angle measurement and was expressed as the work of adhesion. No generic pattern of attachment to the test surfaces was found, although the majority of the organisms isolated showed a preference for the hydrophobic surface. A more detailed study of selected isolates showed a relationship between the work of adhesion and number of attached cells. Each bacterium attached in maximum numbers to a surface that was characteristic of that organism and that had a work of adhesion between 74 and 105 mJ/sq m. (Moore-IVI)
W84-01053

CHLORINE-INDUCED DAMAGE TO SURFACE ADHESIONS DURING SUBLETHAL INJURY OF ENTEROTOXIGENIC ESCHERICHIA COLI,
West Virginia Univ., Morgantown. Div. of Plant and Soil Sciences.
S. M. Walsh, and G. K. Bissonnette.
Applied and Environmental Microbiology, Vol. 45, No. 3, p 1060-1065, March 1983. 2 Fig, 4 Tab, 36 Ref.

Descriptors: *Escherichia coli, *Chlorination, *Fecal coliforms, *Pathogenic bacteria, Bacterial analysis, Indicators, Public health, Infection, Wastewater treatment.

The assessment of the sanitary quality of water may be complicated by the presence of sublethally injured fecal indicator organisms. A portion of the viable population may escape detection by most methods prescribed for the bacteriological examination of water. A comparison of the adhesive ability of noninjured and chlorine-injured enterotoxigenic E. coli was made by in vitro attachment to human peripheral leukocytes. Chlorination selected for noninjured cells with greater capabilities for colonizing the small intestine. Injured populations exhibited reduced association with leukocytes. The maximum reduction was seen in populations with greater than 80% injury. These cells demonstrated less adhesive ability than nonpiliated populations. Electron micrographs suggested that reduced adhesive ability was due to the loss of surface structures as a consequence of sublethal chlorination. The data implied a reduced ability among chlorine-injured pathogens to colonize the small intestine and initiate disease. (Moore-IVI)
W84-01054

MICROBIAL FOULING OF REVERSE-OSMOSIS MEMBRANES USED IN ADVANCED WASTEWATER TREATMENT TECHNOLOGY: CHEMICAL, BACTERIOLOGICAL, AND ULTRASTRUCTURAL ANALYSES,
California Univ., Irvine. Environmental Analysis Div.
H. F. Ridgway, A. Kelly, C. Justice, and B. H. Olson.
Applied and Environmental Microbiology, Vol. 45, No. 3, p. 1066-1084, March 1983. 13 Fig, 3 Tab, 35 Ref. Orange Co. Water Dist. contract 4107-160-81.

Descriptors: *Reverse osmosis, *Membrane processes, *Bacteria, Advanced wastewater treatment, Cellulose acetate membranes, Acinetobacter, Flavobacterium, Moraxella, Pseudomonas, Alcaligenes, Bacillus, Lactobacillus, Wastewater treatment, California, Orange County, Water Factory 21.

Biofouling of reverse-osmosis membranes was investigated at an advanced wastewater treatment facility. Cellulose diacetate membranes operated for approximately 4,000 hr became uniformly coated with a mucilaginous fouling layer. The fouling material was approximately 93% water by weight, and nearly 90% of the dehydrated residue was organic in composition. Calcium, phosphorus, sulfur, and chlorine were the major inorganic constituents detected. Protein and carbohydrate represented as much as 30 and 17%, respectively, of the dry weight of the biofilm. Bacteriological plate counts indicated up to 5,600,000 colony forming units/sq cm of membrane surface. Accumulation of (H3)glucose in the biofilm and measurement of ATP indicated that the fouling bacteria were metabolically active in situ. The genus Acinetobacter and the Flavobacterium-Moraxella group were the major generic groups associated with the feedwater surface of the membrane, whereas species of the generic groups Acinetobacter, Pseudomonas-Alcaligenes, and Bacillus-Lactobacillus predominated of the permeate water surface. Electron microscopy revealed that the biofilm on the feedwater surface of the membrane was 10 to 20 millimicrons thick and was composed of several layers of compacted bacterial cells, many of which were partially or completely autolyzed. The bacteria were firmly attached to the membrane surface by an extensive network of extracellular polymeric fibrils. Polyester (Texlon) support fibers located on the permeate surface of the reverse osmosis membranes were sparsely colonized, suggesting bacterial regrowth in the product water collection system. (Author's abstract)
W84-01057

PEROXIDASE-CATALYZED REMOVAL OF PHENOLS FROM COAL-CONVERSION WASTE WATERS,
Massachusetts Inst. of Tech., Cambridge. Dept. of Nutrition and Food Science.
A. M. Klibanov, T.-M. Tu, and K. P. Scott.
Science, Vol. 221, No. 4607, p 259-261, July, 1983. 1 Fig, 19 Ref.

Descriptors: *Wastewater treatment, *Phenols, *Enzymes, Horseradish peroxidase, Hydrogen peroxide, Coal gasification, Degradation.

An enzymatic approach is described for the removal of phenols from coal conversion aqueous effluents. Upon addition of horseradish peroxidase and hydrogen peroxide, a solution containing phenol immediately turns brown and a precipitate forms gradually, a response not brought on by the use of either reagent alone. Removal efficiencies of 99% can be obtained. The treatment was examined in the practical range of phenol concentrations of from 0.01 to 5 g/liter (pH 9). A typical coal gasification waste water was also examined as it was expected to contain constituents that would adversely affect bacterial and other methods of dephenolization. The sample included: phenol, 2 g/l; ammonia, 5 g/l; chloride, 19 g/l; cyanide, 0.1 g/l; thiocyanate, 1 g/l; and had a pH of 9.0. When 2 units of peroxidase per ml and 2 mM of H2O2 were added to a 0.1 g/l of the test solution a removal efficiency of only 10% was achieved. In the absence of these additional contaminants a 99% removal efficiency had been noted. However, increasing the concentration of phenol to 2 g/l and the concentrations of peroxidase and H2O2 proportionally, the removal efficiency jumped to 97% as compared to a 98% removal efficiency for 2 g/l

phenol in the absence of other contaminants. This indicated that at high, significant phenol concentrations, the presence of contaminants is not an important factor to the operation of this method. Other experiments showed that pollutants such as polychlorinated biphenyls can be enzymatically coprecipitated with the phenols. One possible use of this dephenolization method would be to replace conventional bacterial degradation of phenols in open ponds. This new method would be much less sensitive than bacterial degradation to variations in pH, phenol concentration, other toxic pollutants, and temperature. (Baker-IVI)
W84-01085

CHEMICAL CLARIFICATION OF DREDGED MATERIAL,
Army Engineer Waterways Experiment Station, Vicksburg, MS.
P. R. Schroeder, and F. D. Shields, Jr.
Journal of Environmental Engineering, Vol. 109, No. 2, p 414-427, April, 1983. 3 Fig, 2 Tab, 7 Ref.

Descriptors: *Clarification, *Wastewater treatment, *Dredged material, Effluent, Flocculation, Polymers, Costs, Containment area effluents, Sediments.

Dredged material may be disposed in diked containment areas instead of open water in order to reduce adverse impacts on the aquatic community and water quality and to allow productive use of the dewatered material. Laboratory and design procedures have been developed for chemical clarification of dredged material containment area effluents based on results of laboratory and field tests. The design is suitable for normal disposal operations including remote locations, high and variable flows and solids loadings, and temporary and intermittent operations. The treatment system requires minimal equipment and operations. Low viscosity, highly cationic liquid polymer is applied at the drainage structure of the primary containment cell. Mixing for dispersing polymer and flocculation is provided by turbulence of flow through the discharge culvert. A small secondary cell is used for settling and storage of treated material. Design parameters are determined by jar tests. Major cost components, are polymer, labor, and construction. The cost for equipment, labor, and polymer should range from $0.08/cu yd-0.25/cu yd ($0.10/cu m-0.33/cu m) (1981 dollars) of in situ sediment dredged and is dependent on the production rate, polymer dosage, and treatment system design. (Moore-IVI)
W84-01092

ANAEROBIC TREATMENT OF DILUTE WASTEWATERS USING AN UPFLOW SLUDGE BLANKET REACTOR,
Birmingham Univ. (England). Dept. of Civil Engineering.
C. F. Forster, and D. A. J. Wase.
Environmental Pollution (Series A), Vol. 31, No. 1, p 57-66, May, 1983. 3 Fig, 4 Tab, 17 Ref.

Descriptors: *Anaerobic digestion, *Upflow sludge blanket, *Industrial wastes, *Wastewater treatment, Food-processing wastes, Chemical wastes, Plug flow, Kinetics.

An anaerobic upflow sludge blanket (USB) reactor was used successfully to treat two effluents, a confectionery waste in which sugar was the main component, and a chemical waste of which the principle constituent was acetate, of much lower strengths than those hitherto reported as suitable for such a system. The confectionery waste was mixed with settled domestic sewage to achieve a predetermined strength, and nitrogen and phosphorus were added, in excess, to the acetate waste to ensure that these nutriments were not limiting. Analysis of the results indicated first-order kinetics and plug-flow characteristics within the reactor. Data for COD removal and gas yield showed that this system compared favorably with an anaerobic filter, and also suggested that the confectionery waste was in some way limited, or contained inhibitor, emphasizing a need for preliminary studies. (Moore-IVI)
W84-01114

CONFIRMED VIRUSES VERSUS UNCONFIRMED PLAQUES IN SEWAGE,
Metropolitan Sanitary District of Greater Chicago, IL. Dept. of Research and Development.
J. J. Bertucci, S. H. Abid, C. Lue-Hing, C. S. Clark, and J. D. Fenters.
Journal of Environmental Engineering, Vol. 109, No. 2, p 351-368, April, 1983. 1 Fig, 11 Tab, 18 Ref. EPA grants R803643, 805003.

Descriptors: *Viruses, *Wastewater, *Wastewater analysis, Raw wastewater, Effluent, Public health, Wastewater treatment.

Ninety-two treated and untreated sewage samples from seven wastewater treatment plants in Chicago, Illinois, Memphis, Tennessee, and Cincinnati, Ohio were examined for their virus content. Concentrated and unconcentrated samples were plaque assayed in five different cell culture systems. The virus etiology of plaques was confirmed by passage in homologous cell fluid cultures. Including all plaques tested, only 16.5 % were confirmed as of viral origin. BGM cultures produced the greatest number of unconfirmable plaques. Confirmed virus concentrations for individual samples ranged from less than 0.2 to 80 plaque forming units (PFU)/l. Confirmed PFU's/l averaged 0.7 for raw sewage, 0.5 for preliminary effluents and were not detected in final effluents. A strong recommendation of this study is that the virus etiology of all environmentally derived plaques must be confirmed. (Author's abstract)
W84-01125

INTERMITTENT SHALLOW AERATION OF ANAEROBIC LAGOONS TREATING PIGGERY WASTES,
Animal Research Inst., Victoria (Australia).
M. J. Ginnivan, and P. J. Eason.
Effluent and Water Treatment Journal, Vol. 23, No. 3, p 101 and 103-104, March, 1983. 4 Tab, 8 Ref.

Descriptors: *Animal wastes, *Wastewater treatment, *Aeration, Odor control, Lagoons, Bacteria, Fecal coliforms, Hydrogen sulfide, Anaerobic lagoons, Aerated lagoons, Streptococci.

The effect of intermittent aeration on the degree of odor control and the level of organic pollutants and bacteria in effluents from aerated-anaerobic lagoons was investigated. Perspex columns were used to simulate anaerobic lagoon profiles and were either unaerated (A), aerated for 15 min. and unaerated for 15 min. (B), aerated continuously (C) or aerated for 120 min. and unaerated for 120 min. (D). The average hydraulic retention time was about 128 days. All columns were initially seeded with sludge from an established lagoon which had been treating piggery wastes for 5 years. The mean temperature in all treatments was about 21.0 C and the average pH values were 7.8, 8.2, 8.4, and 7.05 for treatments A, B, C, and D, respectively. All treatments effectively removed organic pollutants from the waste. BOD5 and volatile solids reductions were at least 87 and 83%, respectively. The continuously aerated treatment was the most efficient. The average dissolved oxygen levels in treatments B, C, and D were about 67, 92, and 63% of saturation. While percentage reductions of fecal coliforms and fecal streptococci were high, there were still considerable numbers of viable bacteria in the effluent. The H2S levels associated with the unaerated treatment were above the level reported to present odor problems. H2S levels associated with the aerated treatments were lower than the detection limit of 0.1 ppm due to the ability of the sulfide to be rapidly oxidized. The individual volatile fatty acid concentrations in all treated effluents were less than 0.01 g/l, with the exception of acetic acid in treatment A which was about 0.1 g/l. While waste treatment was effective in all systems considered, the continuously aerated system consistently gave slightly better results than other methods. (Baker-IVI)
W84-01126

WATER UTILITY COMPLIANCE WITH HAZARDOUS MATERIALS, SUBSTANCES AND WASTE REGULATIONS,
Connecticut Water Co., Clinton.
For primary bibliographic entry see Field 5G.
W84-01159

EVAPORATOR CONDENSATES: PRELIMINARY ESTIMATES OF CAPITAL AND ANNUAL COSTS FOR ANAEROBIC FERMENTATION TO METHANE,
Washington Univ., Seattle. Dept. of Chemical Engineering.
P. D. Haggerty, B. Wines, and J. L. McCarthy.
Tappi Journal, Vol. 66, No. 5, p 75-79, May, 1983. 4 Fig, 4 Tab, 15 Ref.

Descriptors: *Pulp wastes, *Anaerobic digestion, *Fermentation, *Costs, Capital costs, Operating costs, Kraft mills, Sulfite liquors, Industrial wastes, Methane.

Although sulfite and kraft pulp mill evaporator condensates account for only 10-15% of the total effluent volume from a pulp mill, they can represent 30-50% of the total biochemical oxygen demand because of their relatively high content of volatile organic substances. The processing of both condensates to produce methane by anaerobic fermentation is being studied, and preliminary estimates of the capital ($1,500,000) and annual ($490,000/yr) costs associated with the processing of 3790 cu m (1,000,000 gal)/day are similar for both condensates. The annual cost included credit for by-product methane production. (Author's abstract)
W84-01166

BIOLOGICAL TREATABILITY OF PENTACHLOROPHENOL WASTEWATER,
Moore, Gardner and Associates, Inc., Baton Rouge, LA.
M. Madden, and M. Tittlebaum.
Journal of Environmental Sciences and Health, Vol. A18, No. 4, p 583-596, 1983. 1 Fig, 1 Tab, 11 Ref.

Descriptors: *Biological wastewater treatment, *Bacteria, Wood preservatives, Pentachlorophenol, Organic carbon, Chemical oxygen demand, Industrial wastewater, Phenols, Microorganisms.

The use of mutant or specialized bacteria in an aerobic treatment system to reduce or stabilize hazardous wastes associated with wood preservatives was investigated in a bench scale biological wastewater treatment system, using a pentachlorophenol wastewater (PCPWW) from a wood-preserving plant. The treatment efficiencies of a naturally occurring microbial system, a commercially available 'mutant' or specialized population, and combination of the two were studied while undergoing acclimation to fullstrength PCPWW in 21 days. TOC and COD removals averaged less than 35 %. The decay rates (k-rates) for the three biological test systems were significantly lower than those typically associated with domestic wastewater. It appeared that the waste oil contained in the PCPWW significantly contributed to the influent COD and TOC. No significant differences were observed in treatment efficiencies measured as TOC and COD. (Moore-IVI)
W84-01184

REMOVAL OF NITROGEN AND PHOSPHORUS FROM WASTE WATER IN A WATER-HYACINTH-BASED TREATMENT SYSTEM,
Florida Univ., Gainesville.
T. A. De Busk, L. D. Williams, and J. H. Ryther.
Journal of Environmental Quality, Vol. 12, No. 2, p 257-262, April-June, 1983. 3 Fig, 4 Tab, 17 Ref.

Descriptors: *Nitrogen removal, *Phosphorus removal, *Biological wastewater treatment, *Water hyacinth, Detritus, Nutrients, Denitrification, Ponds.

The importance of waterhyacinth plant material (living and detrital) as a sink for nitrogen (N) and phosphorous (P) was evaluated in a waste water treatment system in south Florida. The treatment system consisted of four ponds (0.1 ha each) from

which plants were harvested, and one pond (0.2 ha) from which plants were not harvested. Nitrogen and phosphorus were removed in the plant standing crop at higher rates in the harvested ponds (362 and 115 mg/sq m/d, respectively) than in the non-harvested pond (55 and 15 mg/sq m/d, respectively). However, immobilization of N and P as plant detritus in the sediment was less in the harvested ponds (3 and 1% of standing crop assimilation, respectively) than in the non-harvested pond (33 and 13% of standing crop assimilation). With the exception of N in the non-harvested pond, estimates of nutrient removal by the waterhyacinth standing crop and detritus from 4 May-4 Aug. 1981 were similar (within 35 mg N or P /sq m/d) to the observed nutrient removal from the waste water. Denitrification accounted for 92% of the N removed from the non-harvested pond. On an areal basis, approximately 2.4 times more N was removed by denitrification in the non-harvested pond than was assimilated by waterhyacinth growth in the harvested ponds (875 vs. 362 mg N/sq m/d). Mean total N removal from the complete system resulted in an 87% reduction, from 9.96 to 1.25 mg/L. Total P was reduced only 10%, from 4.68 to 4.23 mg/L. (Author's abstract)
W84-01191

ALFALFA, SWEETCORN, AND WHEAT RESPONSES TO LONG-TERM APPLICATION OF MUNICIPAL WASTE WATER TO CROPLAND,
Utah State Univ., Logan. Dept. of Plant Science.
W. F. Campbell, R. W. Miller, J. H. Reynolds, and T. M. Schreeg.
Journal of Environmental Quality, Vol. 12, No. 2, p 243-249, April-June, 1983. 3 Fig, 9 Tab, 34 Ref.

Descriptors: *Land disposal, *Wastewater irrigation, Wastewater disposal, Semiarid lands, Alfalfa, Corn, Wheat, Sodium, Copper, Iron, Zinc, Phosphorus, Municipal wastewater.

The objective of this study was to assess, over two growing seasons, the long-term effects of applying municipal waste water on agricultural land under semi-arid conditions on selected crops. Alfalfa (Medicago sativa L.) cv Ranger, sweetcorn (Zea mays L.) cv Jubilee, and wheat (Triticum vulgare L.) cv Fremont, were grown on land to which waste water had been applied for > 15 y. Plants grown on effluent-irrigated sites had greater growth rates, dry weights, and yields than did plants grown on irrigated control sites. Chemical analyses for metals in plant parts showed that Na was higher in plants growing on the waste water site, whereas Cu, Fe, and Zn were much higher in plants harvested on control sites. Metal concentrations observed in plant materials were below hazardous levels reported in the literature. In general, no significant, detrimental, long-term effects of applying municipal waste water on land under semiarid conditions were detected. In fact, available P levels increased in effluent-irrigated soils. (Author's abstract)
W84-01194

MICROORGANISMS AND HIGHER PLANTS FOR WASTE WATER TREATMENT,
National Space Technology Labs., NSTL Station, MS.
B. C. Wolverton, R. C. McDonald, and W. R. Duffer.
Journal of Environmental Quality, Vol. 12, No. 2, p 236-242, April-June, 1983. 3 Fig, 8 Tab, 15 Ref. EPA 80-D-X0740.

Descriptors: *Biological wastewater treatment, *Biological filters, *Microorganisms, *Aquatic plants, Reeds, Cattails, Rushes, Anaerobic digestion, Bamboo, Biological oxygen demand, Nitrogen removal, Filters.

Batch experiments were conducted to compare the waste water treatment efficiencies of plant-free microbial filters with filters supporting the growth of reeds (Phragmites communis), cattail (Typha latifolia), rush (Juncus effusus), and bamboo (Bambusa multiplex). The experimental systems consisted of two components in series. The first component was an anaerobic settling-digestion container. The second was a 'nonaerated' trough filled with rocks, decreasing from large rocks (up to 7.5-cm diameter) at the bottom, to pea gravel (0.25-to 1.3-cm diameter) at the top. The plant-free microbial filter was equally effective in carbonaceous BOD5 (5-d biochemical O2 demand) removal. The vascular aquatic plant series enhanced ammonia removal, and consequently improved nitrogenous BOD5 removal. Under the conditions of these experiments, raw sewage with initial BOD5's of 100 mg/L can be upgraded to meet secondary standards with 6 h in component 1, and 6 h in a plant-free filter or filter using cattail, rush, or reed. When initial BOD5's are approximately 450 mg/L, 24 h in component 1, 29 h in a reed filter are required to meet secondary standards. Total N removal studies were conducted, which demonstrated that a reed system is capable of removing NO3-N and NH3-N simultaneously, probably through a common NO2-N intermediary, then to N2. Overall, the reed system was superior to all others evaluated in this research project. (Author's abstract)
W84-01195

BEHAVIOR OF CHROMIUM IN SOILS: V. FATE OF ORGANICALLY COMPLEXED CR(III) ADDED TO SOIL,
Cornell Univ. Agricultural Experiment Station, Ithaca, NY. Dept. of Agronomy.
For primary bibliographic entry see Field 5E.
W84-01201

SYNOPTIC REVIEW OF SIGNIFICANT TREATMENT EFFECTS ON CONSENT DECREE PRIORITY POLLUTANTS,
Carollo (John) Engineers, Fountain Valley, CA.
J. E. Tiernan.
Journal of Environmental Health, Vol. 45, No. 6, p 276-282, May/June, 1983. 4 Tab, 63 Ref.

Descriptors: *Wastewater treatment, *Pollutants, *Chlorination, Carcinogens, Mutagens, Teratogens, Coagulation, Filtration, Sedimentation, Adsorption, Ozonation, Water treatment, Priority pollutants.

Recently, the list of 65 consent degree priority pollutants has been expanded to 129 more specific priority pollutants that have been assigned top priority for elimination from U.S. waterways. These pollutants are primarily carcinogens, mutagens, teratogens, and suspected carcinogens, and as such are of concern to environmental health professionals. To determine treatment process alternatives to conventional secondary treatment, which have the most significant effects on concentrations of the consent decree priority pollutants in water and wastewater, an extensive review of the literature was conducted. Five treatment processes which affected the greatest number and concentration of these pollutants were selected for summarizing. These processes are: lime coagulation, sedimentation, and sand or mixed media filtration; activated carbon adsorption; the EPA/Coast Guard Process for Toxic Spills; ozonation; and chlorination. It was determined that four of the five treatment processes could significantly reduce the concentrations of consent decree pollutants. However, chlorination, often legally required by state and public health agencies for surface drinking waters and for wastewaters, caused an increase in both the number and concentration of one-third of the priority pollutants. Pollutants not initially present in the water were produced from organic precursors, and pollutants already present were increased in concentration. (Moore-IVI)
W84-01205

MERCURY, A HAZARDOUS WASTE PROBLEM,
California State Univ., Fresno.
J. Weber.
Journal of Environmental Health, Vol. 45, No. 6, p 284-287, May/June, 1983. 16 Ref.

Descriptors: *Mercury, *Wastewater treatment, *Waste disposal, Heavy metals, Industrial wastes, Water pollution control, Land disposal.

Mercury, in all its chemical forms, is a known toxic substance. Historically mercury has been used in many areas such as art, medicine, industry and scientific research. Although the social benefits have been many, the environment has suffered from an increase in mercury levels due to careless disposal methods with resultant damage to humans and wildlife. Industrial contamination of the nation's waterways has necessitated the development of methods for removing mercury from industrial wastestreams. These methods include precipitation, ion exchange, adsorption on charcoal, solvent extraction and absorption with sulfides. The use of these procedures has reduced the amount of mercury going into the waterways significantly. Disposing of mercury in landfill sites can also be controlled using methods which will keep the mercury contained within solid leak-proof jackets of impervious clay formations. Handled with care, mercury is not a threat to humans or the environment. (Author's abstract)
W84-01206

THE EFFECT OF SUSPENDED SOLIDS IN WASTEWATER ON SOIL HYDRAULIC CONDUCTIVITY: I. SUSPENDED SOLIDS LABELLING METHOD,
Volcani Inst. of Agricultural Research, Bet-Dagan (Israel). Inst. of Soil and Water.
A. J. A. Vinten, U. Mingelgrin, and B. Yaron.
Soil Science Society of America Journal, Vol. 47, No. 3, p 402-407, May-June, 1983. 5 Fig, 4 Tab, 12 Ref.

Descriptors: *Suspended solids, *Land disposal, Wastewater disposal, Effluent, Radioactive tracers, DDT, Leaching, Soil physical properties, Mathematical models.

A method of labelling suspended solids in sewage effluent with C14-DDT (1,1,1, trichloro-2,2-bis(p-chlorophenyl)ethane) is presented. The method allows the vertical distribution of deposited solids in a soil, following leaching with effluent, to be determined. A simple physical model which describes transport of labelled suspension through the soil is developed. This enables the conditions necessary for successful utilization of the method to be defined. Procedures for the estimation of the parameters required for the model are presented and the application of the method is demonstrated for two soils. It is shown that the method for tracing the fate of suspended solids is valid, as long as the label is sufficiently strongly adsorbed on suspended solids. It is also required that the rate of desorption of label from suspended solids be low compared with the residence of mobile suspended solids in the soil. (Author's abstract)
W84-01252

THE EFFECT OF SUSPENDED SOLIDS IN WASTEWATER ON SOIL HYDRAULIC CONDUCTIVITY: II. VERTICAL DISTRIBUTION OF SUSPENDED SOLIDS,
Volcani Inst. of Agricultural Research, Bet-Dagan (Israel). Inst. of Soil and Water.
A. J. A. Vinten, U. Mingelgrin, and B. Yaron.
Soil Science Society of America Journal, Vol. 47, No. 3, p 408-412, May-June, 1983. 6 Fig, 13 Ref.

Descriptors: *Suspended solids, *Wastewater disposal, *Wastewater irrigation, Effluent, Permeability coefficient, Land disposal, Soil surfaces, Leaching.

A method for labelling of suspended solids in sewage effluent is used to trace the distribution of deposited solids in three soils following leaching with effluent. This distribution is related to the effect of sewage effluent application on the soil hydraulic conductivity. A sand, a sandy loam, and a loessial silt loam were studied. The reduction in relative hydraulic conductivity was greatest for the silt loam. This was due to accumulation of solids at the soil surface. In the sand little deposition of solids in the soil and little change in hydraulic conductivity occurred. Results indicate that with proper management sewage effluent can be used for irrigation without causing problems due to lack of soil permeability. (Author's abstract)
W84-01253

EFFECT OF TEMPERATURE ON THE GROWTH OF MICROBIAL FILM IN A MODEL TRICKLING FILTER,
Ashikaga Inst. of Tech. (Japan). Dept. of Civil Engineering.
Y. Honda, and J. Matsumoto.
Water Resources Research, Vol. 17, No. 4, p 375-382, April, 1983. 10 Fig, 2 Tab, 17 Ref.

Descriptors: *Trickling filters, *Temperature effects, *Biological Wastewater treatment, Biological oxygen demand, Growth kinetics, Autolysis.

The daily weight change of a microbial film in a model filter after the start of synthetic feed application was observed and the effect of temperature of the growth of the film was studied. The rate of BOD removal, the rate at which SS was washed out, the yield coefficient and the autolysis coefficient were chosen as the factors related to the growth of the film and the effects of temperature on them were examined. The growth pattern of the film can be divided into the lag-phase, growth-phase and stationary-phase. The growth equation of the film in the growth-phase was obtained by assuming that the rates of BOD removal and SS washed out were constant. In order to evaluate the growth of the film at various temperatures, the growth capacity and the mean growth rate were defined. The growth capacity is the film weight at the stationary-phase and expresses the maximum weight to which the film can increase in a given filter. The growth capacity increased as the temperature fell. This is due to the autolysis coefficient which becomes lower at low temperatures. The period necessary to reach the stationary phase was shorter at high temperatures. The mean growth rate, which was defined as the rate when the film has reached half the growth capacity, was at its maximum at 15 C. (Author's abstract)
W84-01263

OIL REMOVAL FROM WATER IN PARALLEL PLATE GRAVITY-TYPE SEPARATORS,
Amsterdam Univ. (Netherlands). Lab. of Chemical Technology.
J. A. Zeevalkink, and J. J. Brunsmann.
Water Research, Vol. 17, No. 4, p 365-373, April, 1983. 9 Fig, 4 Tab, 15 Ref.

Descriptors: *Separation techniques, *Oil pollution, *Gravity flow, Wastewater treatment.

Aspects of oil removal by gravity separation in parallel plate separators have been investigated both theoretically and experimentally. Attention has been paid to the possible influence of retention time distribution, co- or countercurrent flow (in tilted plate separators) and to the effect of perforation of the plates. Perforation enables an easy removal of separated oil in horizontal plate separators. It appears that the overflow rate, related to the horizontal projection of the real plate area, determines the performance of a plate separator in all these cases. A residence time distribution will lower the separation efficiency only when it is caused by a velocity profile over the width of the tank or by an extremely unequal distribution of the influent over the plates. A tilted full plate separator and a horizontal perforated plate separator with the same overflow rate perform equally well as to separation efficiency; only secondary, practical reasons will determine the choice between either construction. (Author's abstract)
W84-01264

TESTING THE POTENTIAL OF AQUATIC PLANTS TO TREAT ABATTOIR EFFLUENT,
Commonwealth Scientific and Industrial Research Organization, Griffith (Australia). Div. of Irrigation Research.
C.M. Finlayson, and A. J. Chick.
Water Research, Vol. 17, No. 4, p 415-422, April, 1983. 3 Fig, 4 Tab, 32 Ref.

Descriptors: *Biological wastewater treatment, *Food-processing wastes, *Rooted aquatic plants, Cattails, Bulrushes, Phragmites, Trenches, Nutrient removal, Evapotranspiration, Oxygenation.

The potential of 3 genera of emergent aquatic plant species (Typha spp, Phragmites and Scirpus) to ameliorate effluent from a poultry abattoir was evaluated in an experimental trench system. Three plastic-lined trenches containing Typha (two species), Phragmites and Scirpus plants in a gravel substrate were constructed near the abattoir. Effluent was allowed to percolate, with retention times of 2.7 - 3.6 days, through the trenches. The quality of the inflowing and outflowing effluent was compared by a regular sampling program for suspended solids, conductivity, turbidity, pH, dissolved oxygen, Na, K, Cl, N and P concentrations. The importance of water loss by evapotranspiration was investigated. Comparing the inflow to outflow, each trench system successfully reduced the suspended solids (83-89%), turbidity (58-67%), total nitrogen (14-56%) and total phosphorus (37-61%) concentration of the effluent while maintaining an acceptable pH and in the case of the Phragmites and Scirpus systems oxygenating the anaerobic inflow. Conductivity increased in the Typha and Phragmites trenches. If a correction is made for water lost by evapotranspiration, the three experimental trench systems reduced the nitrogen (42-75%), phosphorus (68-79%), sodium (7-34%), potassium (9-56%) content of the effluent. The chloride content of the effluent in the Phragmites system was increased by 15% but was reduced by 31 and 53% in the Typha and Scirpus systems respectively. The results from this initial experiment give an indication of the relative abilities of the three plant systems to treat the wastewater from the abattoir. Of the three that containing the Scirpus was superior. (Author's abstract)
W84-01266

LIMITATIONS OF HEAVY METAL REMOVAL FROM WASTE WATER BY MEANS OF ALGAE,
Tuebingen Univ. (Germany, F.R.). Inst. fuer Chemische Pflanzenphysiologie.
E. W. Becker.
Water Research, Vol. 17, No. 4, p 459-466, April, 1983. 5 Fig, 4 Tab, 2 Ref.

Descriptors: *Heavy metals, *Biological wastewater treatment, *Phytoplankton, *Bioaccumulation, Biomass, Algae, Cyanophyta, Mercury, Cadmium.

It has been suggested by several authors that heavy metals might be removed from aqueous systems by phytoplanktonic algae, whose high capacity for accumulating dissolved metals has previously been described. This paper shows, by comparing results obtained on accumulation factors and growth rates in different modes, that metal removal by means of algae is not feasible in practice. It was found that under optimum conditions in a static system the reduction of a given initial metal concentration by 50% requires approximately 14 days, while in a dynamic model a retention time of approximately 19 days is needed to achieve the same reduction. Finally, measurements of nitrogenase activity inhibition caused by various concentrations of mercury and cadmium demonstrate that nitrogen-fixing blue-green algae can be used for biological sewage treatment only at very low heavy metal concentrations in the medium. (Author's abstract)
W84-01267

MORE TO LEARN ABOUT DISINFECTION,
E. H. Bryan.
Water Engineering and Management, Vol. 130, No. 5, p 26-28, May, 1983. 2 Fig, 8 Ref.

Descriptors: *Sludge conditioning, *Disinfection, Wastewater treatment, Heat treatment, Electron beam, Bacteria, Pasteurization, Irradiation, Chlorination.

An inportant objective of wastewater treatment and sludge management is to reduce the content of pathogenic organisms to levels at which the risk associated with final release to the environment is reasonable and acceptable. The latest developments in the disinfection process for use by the wastewater industry are reviewed. Most of the known physical, chemical and biological agents that are capable of inactivating pathogenic organisms in water or wastewater are of little or no value for disinfection of sludges. Processes that have been shown effective for disinfection of sludges include heat pasteurization, treatment with excess lime, and irradiation with gamma rays or energized electrons. An experimental full-scale unit using cobalt-60 as the source of gamma radiation has been in operation for more than 7 yr in West Germany. Research on the use of energized electrons for sludge disinfection is underway. The feasibility of using sludges in the production of bricks led to a full scale test. The high temperature and several days of residence time within the kiln at the plant resulted in combustion of all organic matter present in the sludge and the formation of a sterile product with the ash residue fixed within a ceramic matrix. During the past decade, the use of chlorine for disinfection of water and wastewater has been subjected to increasing concern about potential risks associated with by-products of its use. (Baker-IVI)
W84-01324

THE TRICKLING FILTER FINDS A NEW PARTNER,
Brown and Caldwell, Walnut Creek, CA.
R. C. Fedotoff.
Water Engineering and Management, Vol. 130, No. 6, p 28-31 and 52, June, 1983. 1 Fig, 3 Tab.

Descriptors: *Trickling filters, *Design criteria, Wastewater treatment, Filters, Filtration, Clarifiers.

After extensive evaluation, the trickling filter/solids contact wastewater treatment process has demonstrated great potential for future use. The process developed out of experimentation conducted at the Corvallis Wastewater Reclamation Plant where it involves primary sedimentation, two conventional rock-media trickling filters, and an aerated channel that carries wastewater to two specially designed secondary clarifiers with center-well flocculation chambers. Gentle stirring in these chambers increases the aggregation of finely divided solids into heavy flow. This floc settles quickly to the bottom of the clarifiers and is removed as sludge. Part of the sludge is returned to the aerated contact channel, mixed with the trickling filter effluent and recirculated to the clarifiers. The remainder of the sludge is pumped to the primary sedimentation tank as waste. The process functions effectively wherever the trickling filter process is applicable, largely because of the flexibility made possible by tradeoffs in the design of its components. An initial design consideration is the size of the trickling filter which governs the quality of the wastewater entering the aeration system. Variables that give the process additional flexibility are the size and residence times in the aerated contact and the return sludge aeration tanks. (Baker-IVI)
W84-01328

SEWAGE TREATMENT PROCESSES - THE SOLUTION TO THE ODOUR PROBLEM,
Mather and Platt Anti-Pollution Systems Ltd., Burgess Hill (England).
R. Anderson.
Water Services, Vol. 87, No. 1046, p 163-166, April, 1983. 2 Fig, 4 Tab.

Descriptors: *Ozonation, *Odor control, *Wastewater treatment, Ozone, Wet oxidation process, Disinfection, Water treatment odors.

The nature of the solution to odor problems encountered in the treatment of sewage may often be found in a deeper understanding of the complex nature of the problem. Such matters as the dilution factor and odor emission values must be measured and determined. The capital cost of any odor abatement system is to a large extent dependant on the air flow involved. Extraction rates should be kept to the minimum sufficient to not only prevent leakage of odors but also to prevent potentially dangerous conditions from occurring As an example of a method of abatement the wet oxidation process is considered. The use of ozone during sewage treatment reduces both the amines and sulfur compounds and further reduces them after scrubbing. In addition to the odor problem, there is also the problem of pollution by microbiological contamination of the environment around a sewage

treatment works. The ozone wet oxidation process is also able to remove a large proportion of the microbiological contamination collected through ventilation systems in enclosed plants. (Baker-IVI)
W84-01334

PERMETHRIN TRIALS IN THE MELTHAM SEWAGE CATCHMENT AREA,
Yorkshire Water Authority (England).
D. Woodhead.
Water Services, Vol. 87, No. 1047, p 198-202, May, 1983. 1 Fig, 7 Tab, 10 Ref.

Descriptors: *Pesticides, *Industrial wastes, *Water pollution effects, Water pollution control, Aquatic life, England, Fish, Permethrin, Mothproofing.

A new mothproofer based on the synthetic pyrethroid permethrin has become available. While this material is biodegradable, permethrin is also extremely toxic to fish and aquatic insects. Trials were conducted at a large commission dyer and scourer on the Meltham, England sewage catchment during which permethrin was used in place of chlorphenylid and dieldrin for two months. The quality of the sewage works effluent appeared not to deteriorate as a result of permethrin use, but the filter biology was affected. Slime began to build up to high levels on certain of the primary filters. The biology of the receiving stream already affected previously by chlorphenylid and dieldrin was shown to deteriorate further. Fish could not be kept alive in the streamwater. Previously noted leakages in the vicinity of the dyeworks were confirmed both chemically in sediments and by biological changes. The situation at Meltham with respect to the mothproofing process is the most critical in Yorkshire with continued mothproofing at existing levels promising to increase an already inferior biological status in the receiving stream. A complete change over to permethrin will almost certainly restrict damage to the Mag Brook system unless demand for mothproofing increases significantly. An additional benefit will accrue from such a change in respect of sludge disposal options, but the change from organochlorine compounds in the catchment will need to be complete. (Baker-IVI)
W84-01335

A UNIQUE OPPORTUNITY TO UPGRADE WATER/WASTEWATER SYSTEMS,
Camp, Dresser and McKee, Inc., New York.
M. Lang, and D. Laredo.
Consulting Engineer, Vol. 61, No. 3, p 75-79, September, 1983. 1 Fig.

Descriptors: *Wastewater facilities, *Water conveyance, *Water treatment, *Utilities, Maintenance, Budgeting, Planning, Political constraints, Cost analysis.

The new awareness of the deterioration of the infrastructure calls for a fresh approach which transcends mere repair or replacement. The underlying premise of this approach is that water and wastewater utilities must be reliable, productive, and profitable. The conventional tools of management - the appreciation of innovations in planning and budgeting, tight administration, new technology, and effective communications - are sufficient to implement this approach. A fundamental first step in planning any program for a system upgrading is a comprehensive inventory of facilities. This should be followed by an assessment of the status or conditions of the facilities, and how they relate to the agency's mission. The next step is program planning, which should consist of a realistic appraisal of what can be accomplished within the budget constraints and political milieu of the municipality. The third step is to include infrastructure upgrading into the agency's capital improvements process. Failures in a system should be diagnosed, and a cost-effective, systematic plan of restoration should be adopted. It is a self-defeating policy to repair breaks in the system as they occur. If the infrastructure is treated as a whole, its restoration will last longer, serve better, and in the long run be less costly. (Moore-IVI)
W84-01336

THEORY OF CLARIFIER OPERATION. VI. THE PRECIPITATION PROCESS IN REACTOR-CLARIFIERS,
Vanderbilt Univ., Nashville, TN. Dept. of Chemical Engineering.
R. M. Strang, K. B. Schnelle, Jr., and D. J. Wilson.
Separation Science and Technology, Vol. 18, No. 3, p 253-291, 1983. 23 Fig, 5 Tab, 19 Ref.

Descriptors: *Clarifiers, *Wastewater treatment, Metal-finishing wastes, Settling velocity, Chemical treatment, Flocculation, Mixing, Ferric hydroxide, Mathematical models.

Reactor-clarifiers are widely used for removal of metals from metal finishing wastewaters. They are similar to standard upflow clarifiers except that the addition of chemicals and the precipitation of solids takes place within the clarifier. A mathematical model is developed for the effect of the rapid-mix step on floc settling velocity in reactor clarifier operation. Data on ferric hydroxide flocs are consistent with the model. The most important parameter is the duration of the rapid-mix step; the longer this is, the more slowly does the floc settle. This is thought to be due to the finite rate at which the precipitation reaction causes the supersaturated solution to decay to equilibrium. There is a possibility of improving the performance of upflow clarifiers by bypassing a small fraction of the influent around the precipitator and introducing it, with mixing, at the entrance to the clarifier. Preliminary pilot scale studies on this look promising. (Moore-IVI)
W84-01365

5E. Ultimate Disposal Of Wastes

NEPTUNIUM AND AMERICIUM SPECIATION IN SELECTED BASALT, GRANITE, SHALE, AND TUFF GROUND WATERS,
Geological Survey, Denver, CO.
For primary bibliographic entry see Field 5B.
W84-01086

CONFIRMED VIRUSES VERSUS UNCONFIRMED PLAQUES IN SEWAGE,
Metropolitan Sanitary District of Greater Chicago, IL. Dept. of Research and Development.
For primary bibliographic entry see Field 5D.
W84-01125

MINNESOTA'S HAZARDOUS WASTE SITING CRITERIA,
Minnesota Waste Management Board, Crystal.
For primary bibliographic entry see Field 5G.
W84-01146

GROUND-WATER MOUNDING DUE TO ON-SITE SEWAGE DISPOSAL,
Santa Clara Univ., CA. Dept. of Civil Engineering.
For primary bibliographic entry see Field 5G.
W84-01154

SIGNIFICANCE OF ATP IN THE SETTLEMENT OF ACTIVATED SLUDGE,
Birmingham Univ. (England). Dept. of Civil Engineering.
A. R. Clarke, and C. F. Forster.
Journal of Chemical Technology and Biotechnology, Vol. 33B, No. 2, p 127-135, June, 1983. 7 Fig, 27 Ref.

Descriptors: *Sludge drying, *Adenosine triphosphate, Activated sludge process, Sludge volume index, Wastewater treatment, Settleable solids, Model studies, Sludge.

The settleability of sludge in relation to its adenosine triphosphate (ATP) concentration was examined using a laboratory-scale activated sludge plant for the treatment of simulated coke oven liquors. Throughout the test the average flow rate was maintained at 2.23 liters/day and the mixed liquor solids at 3.9 grams/liter. The feed-stock contained phenol and thiocyanate as the carbonaceous substrate. Standard analytical procedures were employed. A model describing sludge settlement was derived, based on the concept that the Mohlman or Sludge Volume Index (SVI) is the summation of the individual component settlement indices and that these are dependent on the individual microbial activities as measured in terms of the ATP concentration. Data to validate the model were obtained from a continuous 40 day period of operation during which time the sludge exhibited a series of settlement characteristics with SVI values ranging from 65 to 270. At very high SVI values it was necessary to add small quantities of silicone anti-foam to prevent the sludge buoying in the settlement tank and thereby creating problems of inadequate solids recycling and sludge losses. A linear correlation was supported between the SVI and the mass of ATP per unit mass of sludge solids. Thus, variations in the settlement characteristics of activated sludge, measured in terms of the SVI, can be explained in terms of ATP-activity of the sludge solids and conventional Monod kinetics. (Baker-IVI)
W84-01167

CHARACTERISTICS OF COMBINED EFFLUENT TREATMENT SLUDGES FROM SEVERAL TYPES OF PULP AND PAPER MILLS,
Wisconsin Univ.-Madison.
J. N. McGovern, J. G. Berbee, J. G. Bockheim, and A. J. Baker.
Tappi Journal, Vol. 66, No. 3, p 115-118, March, 1983. 1 Fig, 5 Tab, 11 Ref.

Descriptors: *Sludge disposal, *Pulp wastes, Pulp and paper industry, Industrial wastes, Effluent, Sludge composition, Wastewater treatment, Heavy metals, Nutrients, Wisconsin River.

Combined sludges from 7 primary-secondary effluent treatment systems serving 10 highly diversified pulp and paper operations on the Upper Wisconsin River were analyzed for total solids, carbohydrates, ash, and elemental composition, including plant nutrients and heavy metals. The 7 treatment plants serve 7 integrated wood pulp mills, an integrated recycling mill, a nonintegrated paper mill with a recycling paperboard operation, and a kraft-wood pulp mill. The total daily production of combined sludges from the 7 treatment plants in early 1980 was 199 metric tons. The characteristics of the 7 sludges varied several- fold with pulping and papermaking processes and operations and effluent treatment. Balances were developed between wood and process chemical elements and those elements of the sludges. The suitability of the sludges for land spreading and incineration is considered. (Moore-IVI)
W84-01186

SORPTION AND RELEASE OF CADMIUM BY SOME SEWAGE SLUDGES,
R. Riffaldi, R. Levi-Minzi, A. Saviozzi, and M. Tropea.
Journal of Environmental Quality, Vol. 12, No. 2, p 253-256, April-June, 1983. 1 Fig, 6 Tab, 24 Ref.

Descriptors: *Cadmium, *Sludge, *Adsorption, Fulvic acids, Cation exchange, Langmuir equation, Bonding.

Sorption and release of Cd were determined in nine sewage sludges from Tuscany, Italy. The Cd adsorption data were in agreement with both the linear sorption isotherm and the Langmuir equation. The average of calculated adsorption maxima was about 50% of the mean CEC value, indicating that exchangeable cations present in the sludges were more effective in competing with the Cd ion for exchange sites. The calculated Langmuir adsorption maxima were found significantly correlated with fulvic acid C content and carboxyl and phenolic hydroxyl groups of fulvic acids. The release of Cd retained at two initial concentrations as a function of different extraction solutions was indicated. Extraction experiments showed that Cd may be held in sludges by more than one type of site and that the strength of bonding decreases as the total Cd increases. Cadmium was retained mainly by exchange and complexing sites, the former assuming a relatively more important role as cadmium adsorption increased. The effect of

different exchangeable cations on the sorption of Cd by sludges was also studied. The amounts of Cd sorbed on the sludge surfaces decreased in the order: Ca-sludge > untreated sludge > Fe-sludge = Al-sludge. (Author's abstract)
W84-01192

BEHAVIOR OF CHROMIUM IN SOILS: V. FATE OF ORGANICALLY COMPLEXED CR(III) ADDED TO SOIL,
Cornell Univ. Agricultural Experiment Station, Ithaca, NY. Dept. of Agronomy.
B. R. James, and R. J. Bartlett.
Journal of Environmental Quality, Vol. 12, No. 2, p 169-172, April-June, 1983. 6 Fig, 9 Ref.

Descriptors: *Chromium, *Solubility, *Land disposal, *Sludge disposal, *Wastewater disposal, Organic acids, Heavy metals, Soil contamination.

Organically complexed Cr(III) added to soils may remain soluble, whereas the free Cr(III) metal ion would quickly become adsorbed and/or hydrolyzed and precipitated in the absence of soluble, complexing ligands. To separate these two phenomena, a laboratory procedure was developed to simulate the disposal of Cr(III)-containing organic wastes in soils, and to investigate the solubilities of organic complexes of this heavy metal after addition to soil. The method involves adding Cr(N3)3 to solutions of organic ligands adjusted to a pH between 3 and 8 to form inorganic hydrolyzed species and organic complexes at each pH. After measuring soluble Cr vs. pH, moist soil is added to bring the pH of each Cr-ligand system to 6.5-7.0, thereby precipitating uncomplexed, inorganic Cr(III), and labile Cr(III)-organic complexes. Subtracting Cr(VI) formed from total soluble Cr in the soil suspension gives a relative measure of organically complexed Cr(III) originally present in the aqueous systems at each pH. Citric acid, diethylenetriaminepentaacetic acid (DTPA), fulvic acids, and water-soluble organic matter from air-dried soil kept Cr(III) in solution above pH 5.5, and prevented its immediate removal by soil. Added Cr-citrate remained soluble for at least 1 y in limed samples of an Ultic Hapludalf Ap horizon incubated at field capacity moisture. Because organic acids similar to those studied here may be found in sewage sludge, animal manures, and industrial wastewater. these results should be useful in predicting the fate of Cr(III) added to soils amended with such wastes. (Author's abstract)
W84-01201

SLUDGE DISINFECTED WITH ELECTRON BEAMS,
Ion Physics Corp., Burlington, MA.
J. Morgan.
Water Engineering and Management, Vol. 130, No. 5, p 27-28, May, 1983.

Descriptors: *Sludge conditioning, *Electron beams, *Disinfection, Sludge disposal, Liquid sludge.

Electron beam disinfection was shown to be not only feasible, but also cost-effective for treating municipal sludge. Liquid sludge flows in a vertical free fall as a thin curtain a little over 4 ft wide. As it falls, the sheet of sludge is exposed to a beam of electrons energized by 1.5 million volts with a power of 75 kw. Disinfection takes place in the fiftieth of a second that it takes the sludge to fall through the scanning electron beam. Dosage levels are about 400 krads which raises the temperature of the water only 1 degree C, but reduces the total bacterial count by four or five orders of magnitude. After electron exposure is completed, the effluent line is sampled by a system. The sample plunger extends forward into the process line and pauses. It then withdraws a precise sample regardless of changes in line pressure or other parameters. This final checkpoint assures that the pathogen level of outgoing effluent is below the EPA limit. It also permits analyses of the sludge for water soluble compounds of such metals as cadmium, chromium, copper and lead. At current rates the disinfection of 1,000 gal of liquid sludge, treated with a 400 krad electron dosage requires about 20 kwh of power and costs about $4.00. For sludge containing 4% solids, this is equivalent to about $24.00 per ton of dry material. (Baker-IVI)
W84-01326

5F. Water Treatment and Quality Alteration

CONCENTRATION OF SIMIAN ROTAVIRUS SA-11 FROM TAP WATER BY MEMBRANE FILTRATION AND ORGANIC FLOCCULATION,
Hadassah Medical School, Jerusalem (Israel). Environmental Health Lab.
N. Guttman-Bass, and R. Armon.
Applied and Environmental Microbiology, Vol. 45, No. 3, p 850-855, March, 1983. 1 Fig, 7 Tab, 19 Ref. EPA grant R 806588010.

Descriptors: *Rotaviruses, *Drinking water, *Membrane filters, *Flocculation, Viruses, Water analysis, Public health, Microporous filters, Water treatment.

Rotaviruses are viral agents of gastroenteritis in animals and humans. For determination of the extent of contamination of the environment with these viruses it is essential to have a reliable and sensitive technique for their detection. Most methods of virus concentration have been developed with poliovirus as a representative virus, but this virus differs from rotavirus in many characteristics, including adsorptive behavior and stability. Because simian rotavirus SA-11 resembles the human rotavirus, it is useful as a model for the human disease agents. Two types of filters were compared for their ability to concentrate this virus. Both Zeta Plus 60S and Cox AA type M-780 filters were efficient for virus adsorption, but the efficiency of virus elution was higher with Zeta Plus than with Cox filters. Optimum conditions for virus recovery from Zeta Plus filters included an input water pH of 6.5 to 7.5 and the use of 3% beef extract (pH 9.0) for elution. Under these conditions, an average of 62 to 100% of the virus was recovered in the concentrate. Organic flocculation was used as a second-step concentration method, with average recoveries of 47 to 69%. When the two methods were used to concentrate small numbers (7 to 75 plaque forming units/liter) of input rotavirus, an average of 75 + or - 40% recovery was achieved. With large volumes of input water, recovery was reduced to 16 + or - 7%. (Moore-IVI)
W84-01052

MOUNT ST. HELENS ERUPTIVE IMPACTS TO THE TOUTLE COMMUNITY GROUNDWATER SUPPLY,
Sweet, Edwards and Associates, Inc., Kelso, WA.
H. R. Sweet, and J. E. Edwards.
Bulletin of the Association of Engineering Geologists, Vol. 20, No. 2, p 145-150, May 1983. 4 Fig, 3 Ref.

Descriptors: *Groundwater poilution, *Mt. St. Helens, *Volcanoes, *Water supply development, Phenols, Iron, Taste, Odors, Well yield, Washington, Toutle.

The town of Toutle, approximately 26 mi northwest of Mount St. Helens, has utilized a shallow, high capacity well completed in recent alluvium of the South Toutle River for its water supply since 1974. Debris and mudflow following the May 18, 1980 eruption buried the well and the nearby treatment facility. The town immediately went on water rationing, and tank trucks were employed to haul water to the Toutle Reservoir. Reconnaissance field work showed inadequate stream base flow and no reservoir sites as well as poor infiltration gallery sites along Outlet Creek. Two test wells were drilled on the South Toutle bridge abutment near the old well. Drawdown/recovery tests showed either well capable of producing the necessary sustained yield of 200 gpm. Toutle residents soon complained of an objectionable water taste and medicinal odor. Testing showed the presence of up to 80 micrograms/l total phenols. Phenolic compounds are derived from decaying vegetation, and slow dewatering of the mudflow and debris materials into the underlying alluvium accounted for the microconcentrations of phenols. Field location of existing wells, a resistivity survey and short aquifer tests were conducted on the upper terrace adjacent to Toutle. Two terrace test wells encountered interbedded terrace lahars and alluvium. During drawndown/recovery tests ground water with phenol concentrations of 12 to 15 micrograms/l was recovered. Drill cuttings show fibrous materials similar to the May 18, 1980 mudflow and these phenols are also believed to be derived from the much older organics in the Pleistocene lahars. The high operation and maintenance costs of iron and phenol removal indicate that a 15 mi pipeline to transmit water from the Cowlitz River is the best water supply alternative. (Author's abstract)
W84-01058

TREATABILITY OF WATER,
Univ. Coll., London (England). Dept. of Civil and Municipal Engineering.
K. J. Ives.
Journal of the Institution of Water Engineers and Scientists, Vol. 37, No. 2, p 151-164, April, 1983. 5 Fig, 5 Tab, 17 Ref.

Descriptors: *Water treatment, *Water analysis, Pilot plants, Water quality, Feasibility studies, Water treatment facilities.

The first phase of proceeding towards design of a waterworks is analysis, which often has to be linked with hydrological investigations, to assess variability of water quality with season and water flow conditions. Although analysis of water can provide some clues to its treatability, some other testing is required to establish feasible methods of treatment. Bench scale tests are used to bridge the gap between the laboratory analysis and pilot plant operations; they may also be used in waterworks operation to provide rapid assessment of any changes that may be required in treatment. The next stage is pilot plant testing, which is best done on-site. The scaling criteria are often uncertain, even from pilot scale, and the chemical engineering unit operations approach is to be recommended. (Moore-IVI)
W84-01073

ENSURING WATER QUALITY IN A DISTRIBUTION SYSTEM,
East Bay Municipal Utility District, Oakland, CA.
K. B. Stinson, and K. E. Carns.
Journal of Environmental Engineering, Vol. 109, No. 2, p 289-304, April, 1983. 1 Fig, 11 Tab, 6 Ref.

Descriptors: *Coatings, *Odors, *Taste, *Coliforms, *Water conveyance, *Water quality, Storage tanks, Tetrachloroethylene, Gasoline, Conveyance structures, Drinking water, Organoleptic properties, Corrosion control, Pipes, Particulate matter, Asbestos.

The East Bay Municipal Utility District (EBMUD) has evaluated and resolved several puzzling distribution system water quality concerns which periodically plague most water utilities. Excessive coliform growths, complaints of medicinal tastes and odors, and tetrachloroethylene found in treated waters were all traced to different synthetic organic coatings used to protect the interior surfaces of steel storage tanks. After the repeated failure of several attempts to eliminate these problems, the coatings were removed and replaced. Procedures for approving all new coatings were developed. Complaints of petroleum and gasoline taste and odors were demonstrated to be due to the gasoline permeability of polybutylene and polyethylene service laterals. Copper service laterals are now used as a substitute when needed. The district's gas chromatograph made it possible to solve some of these frustrating mysteries. Although the use of probes, coupons, and chemical indices is helpful in evaluating corrosion problems, the District determined that there is no substitute for the physical inspection of the system. The use of a particle counter and a transmission electron microscope was instrumental in determining the effects of corrosion control practices on particulate and asbestos levels in distributed waters. (Author's abstract)
W84-01124

TETRACHLOROETHYLENE (TCE) CONCENTRATION REDUCTION IN VINYL-LINED ASBESTOS CEMENT WATER MAINS THROUGH THE APPLICATION OF CEMENT MORTAR LININGS,
Haley and Ward, Inc., Waltham, MA.
L. R. Yuskus.
Journal of the New England Water Works Association, Vol. 97, No. 2, p 90-113, June, 1983. 13 Fig.

Descriptors: *Water quality control, *Pipelines, *Tetrachloroethylene, Asbestos cement, Vinyl, Linings, Drinking water, Water pollution sources, Chlorinated hydrocarbons.

Efforts were made in Ashland, Massachusetts to stop leaching of tetrachloroethylene (TCE) into municipal water distribution systems which had been constructed using vinyl lined asbestos cement (VL/AC) water pipes. The vinyl liner was first used in the 1960s as a solution to taste and odor complaints from customers. TCE was used as a solvent, allowing the vinyl polymer resin to be mixed and applied through a spraying process onto the pipes. Two possible solutions to the leaching problem were studied: removal of the vinyl liner and relining of the pipes with cement mortar; or lining the pipes with cement mortar over the vinyl liner. The cement mortar lining of the vinyl lined asbestos-cement pipe considerably reduced the TCE concentrations when compared to pipes in the un-treated condition. The percent reduction appeared to be consistent under both static and dynamic conditions. To date, cement mortar linings have been applied to an existing water distribution system within a local community containing 450 linear feet of VL/AC pipe installed in 1979. Prior to treatment the concentration of TCE in the water passing through these pipes was 145 ppb. The vinyl liner was removed with a series of wire brushes, the line was flushed with water and the cement lining applied. TCE concentrations of 7 ppb were found after the process, amounting to a reduction of about 95%. (Baker-IVI)
W84-01155

DISTRIBUTED COMPUTER CONTROL OF WATER TREATMENT PROCESSES,
Metcalf and Eddy, Inc., Boston, MA.
P. J. Pizzimenti.
Journal of New England Water Works Association, Vol. 97, No. 2, p 150-157, June, 1983.

Descriptors: *Quality control, *Drinking water, Water treatment facilities, Computers, Microprocessors, Management, Filters, Pumps.

Numerous control systems are required in modern water treatment plants in order to ensure the preparation of high quality drinking water in an efficient manner. Controls must manage filter flowrates, filter backwashing, chemical feed systems, pump station operation, filtered water distribution, and the handling of wastewater and sludge. In addition to monitoring and controlling process variables continuously, analog control, digital or discontinuous control is also important and includes such items as opening and closing of valves, starting and stopping of pumps, or the operation of a batch sequence. The most common types of instrumentation used in process control of water treatment plants are pneumatic and electronic. The recent development of the microprocessor has allowed instrumentation and process control equipment to become smaller and more reliable for ongoing control operations. The overall structure of a digital, microprocessor-based distributed control system for a water treatment plant is described. A distributed control system has many advantages, particularly for the larger facilities. Reliability is greatly improved over conventional instrumentation, due to the reduction of electromechanical devices such as relays or indicator and recorder mechanisms, which have a higher rate of failure. A system such as this affords the owner greater flexibility for future expansion of a plant, with little increase in instrumentation hardware, as well as for modifications to a system resulting from experience derived in operating the process. The system also allows for easily correcting those problems which might arise during plant startup. Cost savings are also significant in terms of decreased installation and wiring costs and in the reduction of panel type instrumentation and lower maintenance for the equipment that is needed. (Baker-IVI)
W84-01160

WATER QUALITY FROM WATER-HARVESTING SYSTEMS,
Agricultural Research Service, Tucson, AZ. Southwest Watershed Research Center.
G. W. Frasier.
Journal of Environmental Quality, Vol. 12, No. 2, p 225-231, April-June, 1983. 2 Fig, 6 Tab, 12 Ref.

Descriptors: *Water harvesting, *Drinking water, *Water quality, Arizona, Heavy metals, Arsenic, Precipitation, Runoff, Dusts.

Water harvesting is a technique used to supply animal and domestic drinking water in areas where more conventional methods cannot supply sufficient water. The water collected by a water-harvesting system has the potential of being contaminated by deterioration by-products of the materials used in constructing the system, from dust that is deposited on the catchment surface, or from impurities trapped in the rain. During a 3-y period, runoff water samples were collected for water quality analyses from 10 types of catchment treatments on operational and experimental water-harvesting systems in Arizona. Atomic absorption spectrophotometry techniques were used to determine the concentrations of Al, As, Cd, Ca, Cr, Co, Cu, Fe, Pb, Mg, Hg, K, Na, V, and Zn in each water sample. There was no evidence that deterioration of the catchment treatments would cause a contamination of the runoff water. With the exception of As, most samples had significantly lower concentrations of these constituents than the maximum standards for animal or domestic drinking water supplies. Arsenic was the only chemical consistently found in the water samples at potentially hazardous concentrations for domestic drinking water supplies. Excessive As concentrations were not associated with any specific type of catchment treatment. The logarithm of As concentration in the runoff was positively correlated with the logarithm of the time since the previous rain, and negatively correlated with the logarithm of the total rainfall quantity. Apparently, As was deposited on the catchment surface as dryfall dust, and/or was washed from the atmosphere by the rainfall. (Author's abstract)
W84-01196

EVALUATION OF CARTRIDGE FILTERS FOR THE REMOVAL OF GIARDIA LAMBLIA CYST MODELS FROM DRINKING WATER SYSTEMS,
Sequoia and Kings Canyon National Parks, Three Rivers, CA.
W. R. Long.
Journal of Environmental Health, Vol. 45, No. 5, p 220-225, March/April, 1983. 7 Fig, 7 Tab, 6 Ref.

Descriptors: *Cartridge filters, *Drinking water, *Giardia cysts, Protozoa, Water treatment, Filtration, Particle size, Turbidity, Sand filters.

Numerous waterborne outbreaks of Giardiasis have occurred in recent years in many areas of the United States. Since Giardia lamblia cysts are resistant to chlorination, removing cysts by filtration would be a solution to water treatment. Cartridge filters were analyzed for filter efficiency by the use of turbidity measurements, particle size analysis and scanning electron microscopy analysis. The cartridge filters were challenged by a solution of microspheres (5.7 micrometers in diameter, which is smaller than a Giardia lamblia cyst) at a concentration of 40,000 to 65,000 spheres per ml. Calculations were then performed for turbidity reduction, particle number reduction and visual counts of microspheres. Ten of 17 cartridge filters removed over 99.99% of the microspheres. These would also be effective in removing Giardia lamblia cysts. In several cases, actual performance differed from the manufacturer's micrometer retention rating of the filter. Sand media were not effective in removing the microspheres. (Author's abstract)
W84-01203

ROUTINE COLIFORM MONITORING AND WATERBORNE DISEASE OUTBREAKS,
Columbia Univ., New York. School of Medicine.
O. Batik, G. F. Craun, and W. O. Pipes.
Journal of Environmental Health, Vol. 45, No. 5, p 227-230, March-April, 1983. 3 Tab, 6 Ref.

Descriptors: *Coliforms, *Drinking water, *Waterborne disease, Bacteria, Water quality standards, Water quality, Human diseases.

A comparison of coliform monitoring results was made between water systems experiencing a waterborne outbreak and systems in which an outbreak had not been reported. In a study of community systems, the outbreak and comparison communities were not found to differ in regard to positive coliform results within the three months prior to the outbreak. Also, no statistical difference was observed between outbreak and comparison communities with respect to the number of times the coliform standard was exceeded per number of samples collected and mean number of coliform organisms in the water system during an entire three year period. A study of coliform monitoring results for non-community systems in Pennsylvania show no difference in positive coliform results between non-community systems experiencing an outbreak and those not experiencing one. These data provide no evidence that coliform monitoring provides any prediction of outbreaks of waterborne disease in non-community systems. These results must be interpreted cautiously for several reasons, including small sample size and incomplete reporting of waterborne outbreaks. It is suggested that regulatory agencies should carefully examine the relative importance of the routine coliform monitoring of tap water in the surveillance of waterborne disease. (McKeon-IVI)
W84-01204

USE OF A PILOT PLANT TO IMPROVE WATER TREATMENT CONDITIONS,
W. B. Thomas.
Power Engineering, Vol. 87, No. 9, p 54-55, September, 1983. 1 Fig.

Descriptors: *Pilot plants, *Water treatment facilities, Cooling towers, Demineralization, Desalination.

Use of a small pilot plant, designed to duplicate as nearly as possible the conditions in the full scale equipment, can yield valuable operating data and suggest improvements in the design of the full sized facility. A pilot plant for a demineralization system should duplicate the full sized equipment except for instrumentation. Flow rates during demineralization, rinse, chemical injection and backwash should be the same, but flow distribution, bed pressure drop, and proper backwash bed expansion should not be duplicated. Once the pilot plant is operable the first exercise should be operator training as experience gained will enable operators to more quickly spot malfunctions. After the full sized facility is operating, pilot plants can still be used to study possible improvements in the system, to evaluate the use of new cleaners and other chemicals. With the growing emphasis on plant effluent reduction, pilot sized equipment is becoming increasingly useful in evaluating cooling system operation. The effect of higher water concentrations can be studied without the danger of increased fouling, heavy scaling, or corrosion. (Baker-IVI)
W84-01234

MANAGING A WATER UTILITY,
Richardson Dept. of Public Services, TX.
M. L. Haney.
Southwest and Texas Water Works Journal, Vol. 64, No. 12, p 4-6, 20 and 22, March, 1983.

Descriptors: *Public utilities, *Professional personnel, *Metropolitan water management, Texas, Water quality management.

The major duty and responsibility of any utility manager is to provide good, safe, and potable water to his customers in the quantity required. He must then safely remove the amount of water that

becomes waste and see that this waste does not become a health hazard. The major cost of operating a utility is personnel, and the training, management, and dedication of this personnel is most important. Professional obsolescence is a major hazard as more automation of services and computerization of requirements demands top efficiency from skilled workers. (Wheatley-IVI)
W84-01314

PRIVATIZATION OF WASTEWATER TREATMENT,
Young (Arthur) and Co., New York.
H. J. Goldman, and R. D. Vought.
Southwest and Texas Water Works Journal, Vol. 65, No. 3, p 5-6, June, 1983.

Descriptors: *Wastewater treatment, *Economic aspects, *Private ownership, Community development, Cost allocation.

The private sector has an excellent track record in building and operating wastewater treatment plants to serve its own needs. The economics of owning and/or operating treatment facilities are attractive to the private sector. Privatization is cost effective for the communities as well. It can even compare favorably to a federal grant in terms of user fees. There are several ways in which privatization can be implemented: development of industrial on-site treatment facilities with expansion potential for community growth requirements, sale of community treatment facilities to a local industry, or construction by a private group to service both community needs and industrial requirements. The need for state participation in fostering privatization is evident. Privatization of wastewater treatment is a viable alternative to the financing crisis facing many communities. Privatization is just at the starting line. The private sector is interested, the environmental regulatory agencies are supportive, and the public needs it. (Wheatley-IVI)
W84-01315

GOING DEEP CUTS SEWER, LIFT STATION COSTS,
Winzler and Kelly, Eureka, CA.
M. Kincaid.
Water Engineering and Management, Vol. 130, No. 4, p 26-27, April, 1983. 2 Fig.

Descriptors: *Wastewater facilities, *Pipelines, *Pumps, *Groundwater, Soil water table, California, Costs.

In addition to challenging geotechnical and hydrologic problems encountered during the construction of a pair of Crescent City, California wastewater collection systems, the contractors also had to deal with some touchy archaeological situations. An increase in the number of hepatitis cases in this urban area indicated the need for the updating of the wastewater treatment system. High groundwater was a common problem in the planned construction of the new pipelines. The cost for multiple lift stations required by an above groundwater pipeline system made the cost of a deeper system with fewer lift stations more cost effective. In the construction phase, several burial sites were encountered requiring rerouting of some of the pipelines. Early in 1981, the last segment of the project was completed and placed in operation. (Wheatley-IVI)
W84-01316

SOFTWARE SOLVES WATER SUPPLY PROBLEMS,
H. Rogers.
Water Engineering and Management, Vol. 130, No. 4, p 38-39, April, 1983.

Descriptors: *Computers, *Water supply systems, Management planning, Water supply, Water demand, Water distribution, Costa Rica.

Hydraulics and water resource studies are areas of rapid advancement in computer software technology. It is now possible to take a complete water supply system and analyze it as it stands without alteration or simplification. This new technology was used in a Costa Rica project called the San Jose Water Supply - Stage 2 of the Distribution System - Second Computer Model. The objective was the creation of a computer model in San Jose to serve as a design tool for Costa Rican engineers, enabling them to study the performance of the system and to design extensions as the city expands. The version of the software tailored for use on this computer can analyze a network containing up to 200 nodes and 250 connectors. This computer system has also been used in projects involving communities of populations ranging from 250,000 to 1,250,000. Other water related software programs include AQUIFER, which simulates groundwater levels in an aquifer under complex conditions, SLIPSERF, which is an interactive program for the rapid and economic location of the critical slip circles of non-homogeneous slopes under varying conditions, and LMGEN, which comprises three programs for sewer design. (Baker-IVI)
W84-01321

CLEAR WATER FOR CAYUGA,
MacNeill (John S.) Jr., Homer, NY.
A. W. MacNeill, and J. M. Scanlon.
Water Engineering and Management, Vol. 30, No. 5, p 41-42, May, 1983. 3 Fig.

Descriptors: *Turbidity, *Water treatment facilities, *Water quality control, Drinking water, Lakes, Lake Cayuga, New York, Filtration, Clarification, Clarifiers.

Cayuga Lake provides the potable water supply for an upper New York State village with a population of about 600 and an adjacent town with 92 residential connections. The existing water treatment plant, built in 1935, provides an average of 125,000 gpd of water. The system consists of an intake structure 300 ft offshore and a low pump head to transfer water through an aerator. Water flows from the aerator by gravity through a settling tank and on to a rapid sand filter. Once the filtered water is chlorinated it is discharged to a wet well below grade. Water is delivered through high pressure injection pumps at a rate of 150 gpm. Turbidity levels in the raw water of the lake vary from 1-100 NTU. The high turbidity breakthrough that occurs in the water system is largely due to storm water run-off and wave action in the lake. To combat this problem water is pumped through a cyclone separator. Downstream from the separator, alum is injected into the water at a rate of 10 mg/l to neutralize the electric charge of the suspended particles and form a precipitate. A depth clarifier acts as a contact flocculator. Effluent from the depth clarifiers is fed to a depth filter. A granular carbon system for polishing the water brings the quality within prescribed guidelines. The innovative design includes a top layer of petroleum base carbon with a fine garnet bed to prevent dusting or loss of minute carbon particles in the finished water. Post chlorination is the final step. (Baker-IVI)
W84-01322

COMPUTERISED CONTROL AND MONITORING OF A SWEDISH WATER TREATMENT PLANT,
Skaraborgs Vattenverksforbund (Sweden). Process Industries Division.
B. Karlsson, and B. Kindblom.
Water Services, Vol. 87, No. 1045, p 112-116, March, 1983. 5 Fig.

Descriptors: *Computers, *Water treatment facilities, Automation, Water quality control, Sweden.

The Borgurda Water Treatment Plant in Sweden has a daily capacity of 40,000 cu m of water and meets the needs of 75,000 people. A computerized control and monitoring system was commissioned in 1981 which has raised the efficiency of the production and distribution of pure water and cut down the manning of the plant. There are about 90 km of pipelines, some sections of which are 10, 20, and 30 km long. Raw water intake extends 970 m out into Lake Vattern, at a depth of 16 m. The primary objective of control is to maintain as uniform a flow as possible by leveling out variations in the water consumption with the aid of the water reservoirs. The Hjallo intake station has three raw water pumps with capacities of 750, 1350, and 1800 cu m/hr. It is possible to adapt the water flow to the varying demand in the municipalities with the aid of these pumps. Chlorine and ammonia are added to the water before it is pumped to Borgunda via a reservoir and a booster station. At Borgunda the water is treated in six rapid filters, after which chlorine, ammonia, and lime are added to the water. The Borgunda plant has 10 pump units. Pure water is pumped via reservoirs and a pumping station to elevated reservoirs. The computer center is located at Borgunda from which the water treatment plant and distribution network are controlled and monitored. The central processing unit in the SINDAC system is of type DS 102 with a capacity of 64K words and a 16-bit core memory as well as a moving head disc mass memory, comprising three discs with a total memory capacity of 3.9 million words. The SINDAC system is very reliable and it monitors its own functioning. (Baker-IVI)
W84-01333

A UNIQUE OPPORTUNITY TO UPGRADE WATER/WASTEWATER SYSTEMS,
Camp, Dresser and McKee, Inc., New York.
For primary bibliographic entry see Field 5D.
W84-01336

5G. Water Quality Control

GROUND WATER CONTAMINATION IN THE UNITED STATES,
Academy of Natural Sciences of Philadelphia, PA.
V. I. Pye, and R. Patrick.
Science, Vol. 221, No. 4612, p 713-718, August, 1983. 1 Fig, 1 Tab, 38 Ref.

Descriptors: *Groundwater management, *Groundwater pollution, Water pollution control, United States, Drinking water, Quality control, Legislation, Standards, *Water quality standards.

Since about 50% of the drinking water supply of the United States comes from groundwater sources, contamination of this supply is of increasing concern. The hazards posed by contaminants vary according to the volume discharged, the toxicity of the compounds, their concentration in the aquifer, their persistence in the environment, and the degree of exposure to them. As such contamination occurs underground and out of sight, it is very difficult to observe until the effects are seen in the damage caused, which is often irreversible. The precise source of the contamination may be undeterminable by that point. Sources of groundwater contamination include point sources such as waste dumps, accidental spills, and waste treatment site deposits, along with many nonpoint sources such as agricultural or mining operations. At present there is no federal program dealing specifically with the problem of groundwater contamination. The framework of federal laws that can be used is a group of statutes which are aimed primarily at other environmental problems but which touch indirectly on ground water problems. The EPA did propose a national groundwater strategy in 1980 which included the development of state management and protection strategies, the development of a groundwater classification system, and EPA coordination of existing federal programs for groundwater protection. The technical approach includes the use of siting and design criteria, best management practice, effluent standards, innovative and alternative technologies to achieve performance standards and numerical groundwater quality standards and economic incentives. (Baker-IVI)
W84-01087

MICROBIAL TREATMENT OF SOIL TO REMOVE PENTACHLOROPHENOL,
Cornell Univ., Ithaca, NY. School of Chemical Engineering.
R. U. Edgehill, and R. K. Finn.
Applied and Environmental Microbiology, Vol. 45, No. 3, p 1122-1125, March, 1983. 2 Fig, 1 Tab, 17 Ref.

Descriptors: *Pentachlorophenol, *Pesticides, *Soil contamination, *Arthrobacter, *Water pollution prevention, Bacteria, Cleanup operations, Phenolic pesticides.

Direct innoculation of bacteria capable of degrading pentachlorophenol (PCP) into PCP-contaminated soil was investigated as a prophylactic measure to reduce the hazards of runoffs when spills occur or when wooden poles freshly treated with PCP-containing preservatives are located near streams and lakes. In laboratory tests at 30 C, the direct addition of 1,000,000 PCP-utilizing Arthrobacter cells per g of dry soil reduced the half-life of the pesticide from 2 wk to <1 day. Soil inoculation also was shown to be an effective way to increase the PCP disappearance rate in a test conducted in an outdoor shed. (Author's abstract)
W84-01091

THE REGIONAL EFFECTS OF THE EFFLUENTS FROM THE MISHRAQ SULPHUR MINES IN IRAQ ON THE HYDROLOGICAL SYSTEM,
Mosul Univ. (Iraq).
For primary bibliographic entry see Field 5B.
W84-01105

STORMWATER QUALITY CHARACTERISTICS IN DETENTION BASINS,
Princeton Univ., NJ. Dept. of Civil Engineering.
R. A. Ferrara, and P. Witkowski.
Journal of Environmental Engineering, Vol. 109, No. 2, p 428-447, April, 1983. 10 Fig, 7 Tab, 14 Ref.

Descriptors: *Storm water, *Detention reservoirs, *Water pollution control, Particle size, Chemical oxygen demand, Phosphorus, Nitrogen, Effluents, Sedimentation.

The use of stormwater detention basins for the dual purpose of flood control and mitigation of pollutant runoff loads has been promoted. However, only limited data and methods of analysis and prediction of pollutant removal in detention basins exist. This paper presents the results of a stormwater quality sampling program conducted to describe the particle size distribution and the time variable influent and effluent concentrations of chemical oxygen demand (COD), total phosphorus, total kjeldahl nitrogen (TKN), and solids during various storm events. Concentrations in three separate particle size ranges for each of the four parameters was determined. The basin is shown to be generally effective in reducing solids, COD, and total phosphorus. TKN concentrations and loadings were generally increased. The effectiveness of the detention basin in reducing pollutant loads appears to be related to two factors, namely, equalization and sedimentation. Dry weather water quality in the detention basin determines the importance of the former, whereas the particle size distribution for each pollutant determines the degree of sedimentation. (Author's abstract)
W84-01108

DREDGED MATERIAL SEDIMENTATION BASIN DESIGN,
Army Engineer Waterways Experiment Station, Vicksburg, MS.
R. L. Montgomery, E. L. Thackston, and F. L. Parker.
Journal of Environmental Engineering, Vol. 109, No. 2, p 466-484, April, 1983. 12 Fig, 2 Tab, 8 Ref.

Descriptors: *Sedimentation basins, *Dredged material, *Design criteria, Sedimentation, Storage capacity, Suspended solids, Effluents, Slurries.

Procedures have been developed for designing dredged material sedimentation basins. These procedures can also be used for designing sedimentation basins for other slurries having high suspended solids concentrations. Dredged material sedimentation basins are slightly different from those used in water and wastewater treatment in that the dredged material basins must provide for sedimentation to achieve acceptable effluent quality while providing storage volume for several years of material dredged from local waterways. Guidance is presented for field sampling and laboratory testing required to obtain data for sediment characterization, data analysis, sedimentation basin (containment area) design, and estimating storage capacity required. Settling tests performed in a 8-in. (20 cm) diameter column were found to be satisfactory for defining dredged material settling behavior. Settling behavior in the freshwater environment was best described by a flocculent settling test, while behavior in a salt-water environment was best described by a zone settling test. Procedures are presented for designing new containment areas for suspended solids retention and for evaluating the suspended solids retention potential of existing containment areas during planned disposal activities. The field verification work performed during this research indicated that conservative values could be estimated from laboratory tests for solids concentrations expected in the dredged material sedimentation basins. (Author's abstract)
W84-01109

FEATURES OF FEDERAL LAW THAT ENCOURAGE ADOPTION OF LAND APPLICATION OF WASTEWATER,
Wisconsin Univ.-Madison. Law School.
D. T. Massey.
Journal of Water Resources Planning and Management, Vol. 109, No. 2, p 121-133, April, 1983. 36 Ref.

Descriptors: *Land disposal, *Wastewater disposal, *Sludge disposal, *Legal aspects, Federal jurisdiction, Regulations, Public policy, Water pollution control, Effluents, Standards.

Federal statutes and regulations and Environmental Protection Agency (EPA) guidelines and policies tend to aid and encourage land application of municipal wastewater effluents and sludges and make the method of treatment increasingly attractive. Land application systems are made more attractive by federal law relating to eliminating the discharge of pollutants into navigable waters, stringent standards on discharges from treatment works, and restrictions imposed on permits for discharging effluents and sludges into navigable waters and the ocean. Provisions of federal law tending to aid and encourage land application systems relate to cost-share grants for construction of treatment works, level of effluent and sludge treatment prior to application on land, pretreatment requirements for pollutants introduced into treatment works, federal grants awarded for research and demonstration projects, and requirements for developing public information and education programs. (Author's abstract)
W84-01143

MINNESOTA'S HAZARDOUS WASTE SITING CRITERIA,
Minnesota Waste Management Board, Crystal.
A. P. Shilepsky, and R. B. Pulford.
Journal of Water Resources Planning and Management, Vol. 109, No. 2, p 165-173, April, 1983. 1 Fig, 1 Tab, 7 Ref.

Descriptors: *Waste disposal, *Environmental protection, *Site selection, Legislation, *Minnesota, Management, Groundwater management, Hazardous materials.

Minnesota currently has no commercial hazardous waste disposal facility. Therefore the 1980 Minnesota Legislature created the Waste Management Board, responsible for siting at least one land disposal facility and having the authority to condemn land and supersede local zoning. Minnesota rules prohibit facility location within 1,000 ft of a protected lake, pond, or flowage, or within 300 ft of a protected stream. Siting is also prohibited in natural marshes 10 acres and larger which are eligible for classification as US deep, or open fresh water marshes. Due to the hydrogeologic unpredictability in a topography characterized by sinkholes, caves and underground drainage, attempts were made to remove karst development areas from consideration. Analyses must be performed to determine if leachate, run-off, or other natural processes occurring during facility development will affect nearby protected waters or wetlands. Since both rivers and lakes may be surface sources of drinking water in the state, concern was expressed by some citizens that any downstream water intake, regardless of distance, should eliminate a site from further consideration. The Waste Management Board did not share this view. In order to protect groundwater from contamination, consideration was given to sites which were clay-rich quarternary deposits where regional data indicated sustained well yields of one gallon per minute or less; devoid of major buried quarternary aquifers; composed of Precambrian igneous and metamorphic bedrocks as these are nonaquifers; and possessing a 50 ft or more depth to bedrock. When the site selection was narrowed down to only 20 possibilities, a drilling program was used to further define the groundwater situation, with the presence of an aquiclude becoming a requirement. Specific monitoring methods are to be part of the engineering design examined in the Environmental Impact Statement. (Baker-IVI)
W84-01146

GROUND-WATER MOUNDING DUE TO ON-SITE SEWAGE DISPOSAL,
Santa Clara Univ., CA. Dept. of Civil Engineering.
E. J. Finnemore, and N. N. Hantzche.
Journal of Irrigation and Drainage Engineering, Vol. 109, No. 2, p 199-210, June, 1983. 7 Fig, 1 Tab, 16 Ref. EPA grant P009211010.

Descriptors: *Groundwater mounding, *Wastewater disposal, *Soil disposal fields, Mathematical studies, Wastewater management, Sites, Geohydrology.

Localized ground-water mounding beneath larger on-site sewage disposal fields (leach fields) may be a major problem which previously had not been adequately addressed. Existing methods to predict mounding, mainly developed for ground- water recharge spreading basins, are reviewed for applicability to sewage disposal fields. A most appropriate and accurate method is selected and considerably simplified to provide a convenient, straightforward prediction procedure for regulatory agencies and designers. The major simplification, to a single equation, is particularly accurate after longer wastewater application times, of say 10 to 20 years, when mounding is of most concern. Sensitivities of the procedure to the various simplifications, site factors, and design and management options are discussed and presented in graphical form where significant. Alternative means to reduce mounding are reviewed. Mounding problems and potential mitigation measures should be made more widely known, and long-term field verification of the theory is needed. (Author's abstract)
W84-01154

HOW MASSACHUSETTS PLANS TO MEET THE WATER SUPPLY CHALLENGE OF THE 1980'S,
Massachusetts Div. of Water Supply, Boston.
I. Bhatti.
Journal of the New England Water Works Association, Vol. 97, No. 2, p 114-118, June, 1983. 4 Ref.

Descriptors: *Water supply development, *Water quality control, *Massachusetts, Resources management, Water management, Water shortage, Groundwater management, Water conservation.

New demands for purity and adequacy of supply are being placed on water managers who operate water supply systems and on water regulatory agencies which are responsible for regulating the quality and quantity of drinking water. More than 95% of the population of Massachusetts is served by some form of public water system and the remaining population gets drinking water from individual on-lot wells. More than half the communities are dependent on groundwater sources. A total of 758 municipal water supply wells were recently tested for quality control, with one-third showing detectable amounts of volatile organics and three exceeding the acceptable levels. Water quantity problems also exist in the state, with a rash of

communities experiencing water shortages in 1980 and 1981. Statewide demand has increased from 91 GPCD in 1950 to about 150 GPCD in 1980 and will, at this rate, reach a deficit of 70-140 MGD for eastern Massachusetts by 1990. In an attempt to improve this situation, Chapter 286 of the Acts of 1982 was passed in July of 1982 providing $107.5 million for water supply purposes with $60 million set aside for a Leak Detection and Rehabilitation Program, $25 million for construction of water filtration plants, $10 million for water supply contamination clean-up and to provide a temporary water supply, $2.5 million for water conservation devices in public buildings; and $10 million for the acquisition of land to protect future groundwater sources. (Baker-IVI)
W84-01157

WATER UTILITY COMPLIANCE WITH HAZARDOUS MATERIALS, SUBSTANCES AND WASTE REGULATIONS,
Connecticut Water Co., Clinton.
T. R. Marston.
Journal of New England Water Works Association, Vol. 97, No. 2, p 134-137, June, 1983.

Descriptors: *Regulations, *Hazardous materials, *Utilities, Sludge, Water treatment facilities, Wastewater.

One area of concern is the transporting of treatment chemicals from a central location to outlying treatment stations by water department trucks. The most difficult aspect of complying with the regulations for transporting hazardous materials often concerns shipping papers. If an amount of a hazardous substance equal to or greater than its reportable quantity is to be transported, it must be so noted on the shipping papers. Concerning waste generated by the water industry, the largest quantity is sludge which is not classified as a hazardous waste by the EPA. However, there is concern over the possible toxicity of this material. Additional hazardous wastes can be generated at water utilities if a company cleans water meters in an acid or caustic solution or if spills in the chemical feed system are retained in a vault or waste tank. If a company generates less than 1000 kg (454 lb) of waste in a calendar month, it is classified as a small quantity generator and does not have to meet the registration, personnel training, contingency planning and emergency requirements of a larger generator of hazardous waste. A small quantity generator must still handle and dispose of the waste in such a way as to meet all regulatory requirements, including packaging, marking and labeling waste to meet all Department of Transportation regulations as well as additional EPA marking requirements for hazardous waste, and offering the waste to a licensed transporter for disposal at a licensed treatment, storage and disposal facility. (Baker-IVI)
W84-01159

MANAGING RUNOFF FROM A SMALL, PAVED BEEF FEEDLOT,
Science and Education Administration, Coshocton, OH. North Appalachian Experimental Watershed.
W. M. Edwards, L. B. Owens, and R. K. White.
Journal of Environmental Quality, Vol. 12, No. 2, p 281-286, April-June, 1983. 8 Fig, 2 Tab, 14 Ref.

Descriptors: *Feedlot runoff, *Water pollution control, Wastewater management, Storm runoff, Settling basins, Filter strips, Nutrients, Biological oxygen demand, Chemical oxygen demand, Settleable solids, Infiltration.

Each year for 3 yr, 56 steer calves were fed to market weight on a corn-silage and shelled-corn ration in a 243-sq m paved lot. Storm runoff was measured and sampled as it left the feedlot, and again after it passed through a shallow, concrete settling basin and two consecutive 30 m long by 4.5 m wide sod filter strips. Storm runoff amounts and transport of TS (total solids), COD (chemical oxygen demand), BOD5 (5-d biological oxygen demand), N (total nitrogen), and P (total phosphorus) were smaller during the fall and winter months, when the steers were small and being fed silage than during May through July, when the animals were larger and eating shelled corn. The settling basin reduced transport of TS and COD by about 55%, while retaining only 35-40% of the BOD5, N, and P. Total reduction of all parameters was increased to 80-90% in the filter strips. The basin was more effective in large storm events, and the filter strips were more effective when the basin was slowly drained after settling of the settleable solids. Rainfall on the filter strips reduced the concentration of all parameters during large storms, and infiltration during other events reduced transport to downstream areas. (Author's abstract)
W84-01189

EFFECTS OF POPULATION AND INDUSTRIAL CHANGE ON ENVIRONMENTAL QUALITY IN MAJOR CONURBATIONS,
Victoria Univ. of Manchester (England). Dept. of Economics.
N. Lee, and C. Wood.
Journal of Environmental Management, Vol. 16, No. 2, p 91-107, March, 1983. 3 Fig, 5 Tab, 30 Ref.

Descriptors: *Urban areas, *Environmental quality, Industrial wastes, Domestic wastes, Human populations, Population dynamics, Urban planning, Forecasting, Environmental control.

The environmental quality which can be achieved in a conurbation depends as much upon its domestic and industrial activities as on the environmental protection measures which are enforced. An analytical framework is developed to identify the main relationships between these variables. The framework is used, first, to examine the relationship between population and industrial change and environmental quality in Greater Manchester (England) for the years 1966-76, using published or otherwise accessible data. Large changes are shown to have taken place in the level, composition and spatial distribution of waste generating activities over this period. Data describing these changes are used in conjunction with information relating to waste coefficients and emission factors to explain the main changes in environmental quality that occurred in the conurbation over the period. The analytical framework is then used, in conjunction with economic and population forecasts, to determine likely future changes in population and industrial structure by the mid-1980s and their probable consequences for waste and pollution levels in the conurbation. These preliminary analyses form the basis for the further development of this type of forecasting study, preferably in cooperation with existing planning and environmental control authorities. A two-stage approach to environmental forecasting appears to be the most promising way to proceed. The first stage would produce strategic forecasts for large zones using more readily accessible data and thereby identify environmentally significant areas or activities for further study. The second stage would consist of more detailed studies, involving the collection and analysis of additional survey or cast study material for the areas or activities so identified. (Author's abstract)
W84-01207

SOIL MANAGEMENT AS IT AFFECTS NUTRIENT LOSSES FROM A TROPICAL SOIL IN NIGERIA,
Ibadan Univ. (Nigeria). Faculty of Technology.
G. E. Osuji, and O. Babalola.
Journal of Environmental Management, Vol. 16, No. 2, p 109-116, March, 1983. 6 Tab, 19 Ref.

Descriptors: *Soil management, *Tillage practices, Nutrients, Agricultural runoff, Leaching, Nitrogen, Soil erosion, Water pollution sources, Storm seepage, Fertilizers.

Five tillage treatments, namely bare fallow, no-tillage, local or manual tillage, plowing only, and conventional tillage (plowing and harrowing), were established on runoff plots on an alfisol with a 5% slope in southern Nigeria. The objective was to determine the effects of these tillage practices on nutrient losses in runoff and soil erosion from shallow soils derived from basement complex rocks. Nutrient losses in both runoff and eroded sediments were in the order: bare fallow > plough > conventional > manual > no-tillage. In all cases, nitrogen suffered the greatest loss. Nutrient losses in runoff water were not very high, but their relative concentrations in runoff could pose potential environmental pollution hazards. Leaching losses of nitrogen, as shown by higher concentrations of NO3-N in the subsurface or inter-flow water, were higher than losses in runoff water, and this may account for the relatively low efficiency of applied nitrogen fertilizers in tropical soils. The no-tillage technique was found to be an effective means of checking loss of nutrients from agricultural land in the tropics. (Author's abstract)
W84-01209

THE DEPENDENCE OF SHORELINE CONTAMINANT LEVELS UPON THE SITING OF AN EFFLUENT OUTFALL,
Cambridge Univ. (England). Dept. of Applied Mathematics and Theoretical Physics.
R. Smith.
Journal of Fluid Mechanics, Vol. 130, p 153-164, 1983. 5 Fig, 7 Ref.

Descriptors: *Outfall, *Environmental effects, *Advection, *Diffusion, Water pollution control, Path of pollutants, Mathematical models, Effluents, Shores.

It is shown that the advection-diffusion equation for contaminant dispersion in water of variable depth admits of an inverse approach in which the stochastic mean concentration at a fixed sensitive location is calculated for arbitrary discharge sites. A ray method is used to obtain simple approximate solutions for the inverse problem when the sensitive location is situated at the shoreline. This makes explicit the considerable improvements in shoreline pollution levels which can be gained by siting effluent outfalls further away from the shore. (Author's abstract)
W84-01238

ACTIVE VERSUS PASSIVE WATER QUALITY MONITORING PROGRAMS FOR WASTEWATER DISCHARGES,
Texas Tech Univ., Lubbock. Dept. of Civil Engineering.
G. F. Lee, and R. A. Jones.
Journal of the Water Pollution Control Federation, Vol. 55, No. 4, p 405-407, April, 1983. 6 Ref.

Descriptors: *Water quality control, *Water management, Data acquisition, Monitoring, Water pollution control, Wastewater treatment, Wastewater facilities, Sampling, Hazard assessment.

The first step that should be considered in developing cost-effective technically valid, active water quality monitoring programs is to determine which aspects of water quality are of concern to a particular location, i.e., to what uses the water under study is to be put. A hazard assessment approach should guide both the development of a monitoring program and the interpretation of the results. Such an approach allows the physical, chemical and biological characteristics of the water to be considered in light of their potential impact on beneficial uses of the water by man. The water quality monitoring program should incorporate sampling sites and frequencies and parameters for measurement that have sound technical justification. It should be flexible enough so that it can be adjusted on the basis of analytical findings, and there should be a short turn-around time between sample collection and data review by those responsible for water quality control at the site. Rigid, fixed-station, fixed-period sampling should be reduced and supplemented with special purpose sampling where needed. Part of the funds available should be devoted to toxicity testing as chemical analyses generally do not provide reliable indications of water quality impairment. (Baker-IVI)
W84-01241

MONITORING FOR WATER QUALITY: FIXED STATIONS VERSUS INTENSIVE SURVEYS,
Washington Univ., Seattle. Dept. of Biostatistics.
G. van Belle, and J. P. Hughes.

Journal of the Water Pollution Control Federation, Vol. 55, No. 4, p 400-404, April, 1983. 1 Tab, 11 Ref.

Descriptors: *Monitoring, *Water quality control, *Sampling, Water sampling, Networks, Water pollution control, Surveys.

Objective limits and definitions of water quality were needed, along with effective methods of measuring, and these tasks were given to the EPA for development. The three major responsibilities were to administer funds for the construction of municipal waste treatment plants, set effluent limitations and define the technological standards that must be used to achieve these limits, and to collaborate with the states in monitoring water quality and preparing annual reports on the nation's water quality. A network of water quality monitoring stations has since been developed across the country to serve as a natural starting point for the creation of a fixed station network. In the controversy of intensive surveys vs fixed stations, the data suggests that intensive surveys do not provide a valid, cost effective evaluation of long-term in water quality. Rather, they are effective for studying short-term fluctuations in other hydrological phenomena, and cause-effect relationships of pollution. A network of stations selected probabilistically will provide valid estimates of water quality and trends in water quality. The price of this generalizability is increased variability of the estimates. Estimates derived from an intensive survey of a small area will be less variable, but will not be generalizable. Estimates derived from networks selected by non-probabilistic means may produce biased estimates of absolute water quality, but can give valid estimates of trends with less variability. Routine sampling of a well defined, fixed number of parameters can significantly reduce sampling costs. Uniformity and quality of data collected need to be improved in both the field and lab. Fixed network monitoring programs can provide valid regional and national information about trends in water quality. (Baker-IVI)
W84-01242

DRAINAGE QUALITY AT DEEP COAL MINE SITES,
Pennsylvania State Univ., University Park. Inst. for Research on Land and Water Resources.
D. L. Wirries, and A. J. McDonnell.
Water Resources Bulletin, Vol. 19, No. 2, p. 235-240, April, 1983. 3 Fig, 3 Tab, 16 Ref.

Descriptors: *Coal mine, *Mine drainage, *Acid mine drainage, Trace metals, Overburden, Water quality, Overburden, Calcareous materials.

Samples were collected from the drainages of inactive deep coal mine sites located in eight states. Drainage quality was found to be highly variable, with a majority of sites exceeding federal effluent quality guidelines. Concentrations of trace metals including cadmium, mercury, zinc, and nickel were low. The presence of overburden calcareous material was shown to affect drainage quality. A consistent pattern of pH-acidity response was found to exist for the mine sites monitored. An empirical formula was developed to characterize this response. (Author's abstract)
W84-01281

EFFECTS OF LAND USE AND TOPOGRAPHY ON SOME WATER QUALITY VARIABLES IN FORESTED EAST TEXAS,
Stephen F. Austin State Univ., Nacogdoches, TX. School of Forestry.
M. Chang, J. D. McCullough, and A. B. Granillo.
Water Resources Bulletin, Vol. 19, No. 2, p 191-196, April, 1983. 1 Fig, 3 Tab, 27 Ref.

Descriptors: *Land use, *Topography, *Forest watersheds, Small watersheds, Suspended sediments, Water quality, Drainage density, Nitrogen, Phosphorus, chloride, Texas.

Spatial variation of five water quality variables were analyzed using composite water samples collected periodically from eight small watersheds (11.4-71.6 sq km) in forested East Texas during 1977 through 1980. Based on 31 observations during the four-year period the average yield of nitrate-nitrite nitrogen (NNN), total kjeldahl nitrogen (TKN), total phosphorus (PO4), chloride (CHL), and total suspended sediment (TSS) were 1.43, 21.96, 3.09, 50.11, and 90.39 ka/ha/yr, respectively. Compared to the water quality standards of the U.S. Environmental Protection Agency (1976) and the Texas Department of Water Resources (1976) for CHL, TSS and NNN, none of the observations exceeded the limits for public water supplies. The study showed that forested watersheds normally yielded stream flow with better quality than that from agricultural watersheds. Watersheds of greater percent of pasture area, mean slope, stream segment frequency, and drainage density produced greater concentrations for these five chemical parameters in water samples. Meaningful equations were developed for estimating mean average yields for each chemical parameter for each watershed with R(2) ranging from 0.77 to 0.96 and standard error of estimates from 17 to 33 of the observed means. (Author's abstract)
W84-01288

THERE IS AN ANSWER TO GROUNDWATER CONTAMINATION,
Calgon Corp., Pittsburgh, PA.
R. P. O'Brien, and J. L. Fisher.
Water Engineering and Management, Vol. 130, No. 5, p 30-36 and 70, May, 1983. 6 Fig, 4 Tab.

Descriptors: *Activated carbon, *Water quality control, *Groundwater pollution, Water treatment, Drinking water, Organic compounds.

Granular activated carbon (GAC) is being increasingly used to treat and purify contaminated groundwater. Results from 31 different operating plants that employ GAC to remove toxic organic compounds from groundwater supplies are detailed. Sources of contamination of the groundwater included leachate from lagoons and dumpsites, industrial accidents and spills, and spills resulting from railroad or truck accidents. Industrial accidents accounted for 22 of the 31 sources. The data clearly demonstrated that ability of GAC to remove a wide range of organic compounds from the water. Trichloroethylene and tetrachloroethylene were the most frequently detected compounds. Experience suggests that the downflow fixed bed is more cost-effective than a pulsed-bed for groundwater treatment. At 22 of the sites, treatment of groundwater prior to carbon adsorption was not required. These contaminated supplies were stable and contained low concentrations of suspended solids which could be removed in the carbon bed without hindering adsorption or creating a high pressure drop. Contact time is a particularly important design parameter for any adsorption system. To improve carbon efficiency where longer contact times are needed, two adsorbers are usually required. Operating costs with GAC treatment are dependent on a number of factors including flow rates, concentration and type of organics, type of applications, sites requirements, timing requirements, and length of the processing project. As expected, the operating costs for GAC treatment was lower in the case of those projects with lower average influent levels of contaminant. (Baker-IVI)
W84-01323

PROTECTIVE PONDS SAVE ECORSE CREEK,
Wade, Trim and Associates, Inc., Taylor, MI.
D. R. Trim.
Water Engineering and Management, Vol. 130, No. 6, p 48-50 and 58, June, 1983. 3 Fig, 1 Tab.

Descriptors: *Sewer systems, *Settling basins, *Combined sewer overflows, Overflow channels, Construction, Water pollution control, Aeration.

Serious combined sewer overflow problems in several Michigan communities have been solved through the institution of two large retention basins, one covered and incorporating a jet aeration system, and one open. The less expensive, the open stormwater basin, was built under a $2,396,576 construction contract and required about 612,000 cu yd of earth excavation along with the installation of a pumping station, 2,000 ft of 8-in to 60-in diameter sewer and 900 ft of relocation water main. A sewer separation project under another contract routes storm water to it through 7,000 ft of 54-in to 132-in diameter reinforced concrete pipe. The enclosed retention basin was built for $6,489,256 as a 530 ft long by 190 ft wide structure extending 25 ft below grade. Up to about 22,000 gpm of the pumping station's capacity can be used to keep solids in the wastewater stored in the basin in suspension. Constructed at the downstream end of the 54-in interceptor that routes combined flows out of the Ecorse Creek basin, the retention structure is designed to go on-line when flows rise above the 14.2 cfs level, storing up to 13 mil gal of wastewater in both of its chambers if necessary. Since its use, basement flooding was eliminated and the pollution of the creek has been drastically reduced. (Baker-IVI)
W84-01325

A CONCEPTUAL FRAMEWORK FOR MEASURING THE BENEFITS OF GROUNDWATER PROTECTION,
Environmental Protection Agency, Washington, DC. Office of Policy Analysis.
R. L. Raucher.
Water Resources Research, Vol. 19, No. 2, p 320-325, April, 1983. 4 Tab, 15 Ref.

Descriptors: *Groundwater protection, *Cost-benefit analysis, Policy making, Groundwater pollution, Waste disposal, Water use, Geohydrology.

There is an increasing concern regarding the contamination of groundwater by hazardous materials. This concern is now being translated into private and public sector initiatives to implement waste disposal and other policies designed to protect groundwater. These activities generate substantial costs; the purpose of this paper is to establish a framework with which to measure the benefits of such efforts to protect groundwater. This benefits framework is based on the premise that the probabilistic value of protection is at least as great as the expected costs of contamination. These costs are shown to be sensitive to a variety of site-specific hydrogeologic and water use factors and general economic parameters. By facilitating benefit-cost comparisons, the framework provided here should help direct groundwater protection resources to their most efficient uses. (Author's abstract)
W84-01337

INCORPORATING THE STOCHASTIC NATURE OF WATER QUALITY INTO MANAGEMENT,
Colorado State Univ., Fort Collins. Dept. of Agricultural and Chemical Engineering.
R. C. Ward, and J. C. Loftis.
Journal of the Water Pollution Control Federation, Vol. 55, No. 4, p 408-414, April, 1983. 1 Fig, 30 Ref.

Descriptors: *Water quality management, *Stochastic process, Hydrologic cycle, Water quality standards, Statistical methods, Sampling, Monitoring, Networks.

Water quality in a stream or river is the result of two primary causal mechanisms: the activities of society, and the natural hydrologic cycle. Water quality management must deal with both, even if it does attempt to control only one - the activities of society. Both mechanisms may be described as stochastic processes in that each, to some degree, is governed by the laws of chance. Thus, water quality, from a broad management perspective, can be considered a random variable. While past water quality management efforts were soundly based on the state-of-the-art knowledge of the time, the new knowledge must now be incorporated into the management structure, or the structure must be modified to reflect the new knowledge. Several of the implications to management of incorporating concepts of water quality hydrology and statistical sampling are reviewed. Water quality standards should be interpreted in relation to probabilistic information derived from a statistically designed and operated, fixed-station monitoring network. (Moore-IVI)
W84-01397

6. WATER RESOURCES PLANNING

6A. Techniques Of Planning

WAYS TO INCREASE THE EFFICIENCY AND RELIABILITY OF OPERATING HYDROELECTRIC STATIONS WITH MULTIPURPOSE RESERVOIRS,
For primary bibliographic entry see Field 8C.
W84-01065

USE OF RECREATION ANALYSIS IN RESOURCE MANAGEMENT: A CASE STUDY,
Massey Univ., Palmerston North (New Zealand). Dept. of Agricultural Economics and Farm Management.
B. S. Harris, and A. D. Meister.
Journal of Environmental Management, Vol. 16, No. 2, p 1117-124, March, 1983. 3 Fig, 2 Tab, 6 Ref.

Descriptors: *Recreation facilities, *Resources management, *Lakes, Resource allocation, Economic evaluation, Cost-benefit analysis, Decision making.

The value of specific recreation sites is often an important consideration in resource management. The aim of recreation analysis is to derive a monetary value for such sites, providing a comparative figure for efficient resource allocation between alternative uses. The paper summarizes a particular recreation analysis carried out on a lake in the North Island of New Zealand. The methodology is based on the accepted travel cost approach which provides an estimation of the consumers' surplus associated with visitation to a public good type recreational amenity. The results of the study are discussed in relation to their usefulness in resource management decision-making and applicability to cost-benefit type economic evaluations. (Author's abstract)
W84-01210

ECONOMIC RESOURCE MULTIPLIERS FOR REGIONAL IMPACT ANALYSIS,
Max C. Fleischmann Coll. of Agriculture, Reno, NV. Div. of Agricultural Economics.
T. R. Harris, and C. T. K. Ching.
Water Resources Bulletin, Vol. 19, No. 2, p 205-210, April, 1983. 1 Fig, 2 Tab, 8 Ref.

Descriptors: *Economic aspects, *Income, *Water use, *Model studies, Regional development, Employment, Nevada.

Tradeoffs between regional economic development and resource use is a question often confronting local decision makers. A resource-interindustry model can be used to depict the interrelationships between regional economic sectors as to household income and/or employment and resource use. A resource-interindustry model was developed for Humboldt and Lander Counties in Nevada which shows the tradeoffs between regional household income (wages, salaries, profits, and rents) and/or employment and water usage. Water income and water employment multipliers can be ranked, enabling decisionmakers to realize sectors which require greatest regional water usage to regional household income and/or employment. (Author's abstract)
W84-01286

SOFTWARE SOLVES WATER SUPPLY PROBLEMS,
For primary bibliographic entry see Field 5F.
W84-01321

6B. Evaluation Process

REGIONAL VERSUS LOCAL WATER SUPPLY PLANNING,
Corps of Engineers, Baltimore, MD. Baltimore District.
J. E. Crews.
Journal of Water Resources Planning and Management, Vol. 109, No. 2, p 179-185, April, 1983. 2 Fig, 1 Tab.

Descriptors: *Regional planning, *Water supply development, *Metropolitan water management, Cost analysis, Local governments, Water policy, District of Columbia, Metropolitan Washington D.C. area.

The Metropolitan Washington, D.C., area water supply study being conducted by the U.S. Army Corps of Engineers presents an approach in planning for water supplies that can lead to regional management. The challenge, however, rests with the local decision-makers in seeing that a management plan is adopted for the Metropolitan Washington area. Unfortunately, local governments find themselves in a dilemma revolving around the economic and self-sufficient nature of governance. This paper explains how the Metropolitan Washington area has reached a point when new supplies must be developed. The area's supply base is a finite resource where previous independent actions have not caused any serious problems. Now there are obvious advantages in cooperating to develop a regional water policy as well as sharing in the development of cost-effective solutions. (Author's abstract)
W84-01141

THE ENVIRONMENTAL MONITORING PROGRAM FOR THE WATERSHED OF THE GREAT POND AND RICHARDI RESERVOIRS,
Stone and Webster Engineering Corp., Boston, MA.
J. D. Cleggett.
Journal of the New England Water Works Association, Vol. 97, No. 2, p 119-133, June, 1983. 8 Fig.

Descriptors: *Watershed management, *Reservoirs, Water supply development, Groundwater mining, Water shortage, Surface drainage, Groundwater reservoirs, Wetlands, Reservoir evaporation, Massachusetts, Great Pond Reservoir, Richardi Reservoir.

The towns of Braintree, Randolph, and Holbrook in Massachusetts consume water from the Great Pond Reservoir and the relatively new Richardi Reservoir. The water is basically runoff water from a 10 sq mi watershed comprised of four major wetland areas, connected by a system of brooks and rivers. The drought condition existing since the beginning of 1980 has caused a reduction in supply, forcing the town to impose restrictions on the use of water and to prepare emergency plans to augment the supply. Baseline data about the watershed is used to identify adverse changes and to initiate corrective action directed towards maintaining the area in its present or improved condition. Precipitation is measured daily for each 24 hr period, and is used to indicate the present pattern of rainfall. The inflow to the reservoirs is continually measured to indicate how much water is collected, how long it takes the wetlands to drain into the reservoirs, and how much water comes from each collection area. Once it has been determined which rivers are the major sources, clean-up efforts can be concentrated on those first. Daily consumption is also recorded so as to prepare a projection of future demands. Evaporation is calculated daily for each reservoir to aid in determining whether covers over reservoirs will offer significant help. Water quality throughout the watershed is tested monthly and the entire watershed area is inspected monthly. The second aim of the study is to develop a proposed project to increase the source of supply. A project has been presented and work has begun to excavate certain areas of the Richardi Reservoir which it is believed will intersect groundwater below the Reservoir. Estimates indicate the yield from this new source could be as high as 4 million gpd. (Baker-IVI)
W84-01158

PRIVATIZATION OF WASTEWATER TREATMENT,
Young (Arthur) and Co., New York.
For primary bibliographic entry see Field 5F.
W84-01315

6D. Water Demand

WATER ALLOCATION CONFLICTS ON THE CANADIAN PRAIRIES,
Manitoba Univ., Winnipeg. Dept. of Civil Engineering.
I. C. Goulter, and B. Webb.
Journal of Water Resources Planning and Management, Vol. 109, No. 2, p 147-164, April, 1983. 8 Fig, 3 Tab, 20 Ref.

Descriptors: *Competing use, *Water demand, *Irrigation water, *Resources development, *Hydroelectric power, *Canada, Prairies, Consumptive use, Water allocation, Water shortage.

The conflicts between water demands for energy production and irrigation development on the Canadian prairies and the available supply are reviewed. The water requirements for energy production in the western provinces of Alberta and Saskatchewan arise from the development of oil sands and heavy oil. Manitoba has a large amount of developed and potential hydroelectric capacity. While a considerable area in the prairies is presently irrigated, a very large increase in irrigated area is possible in the forseeable future. All major rivers in the prairie provinces flow from west to east. Consumptive uses in the western parts of the region reduce the potential for water-based developments in the east. Ground water is not a feasible source of supply across much of the region. A water allocation agreement is currently in force among the three provinces. While there are not problems apparent with the present allocation, areas of potential conflicts have been identified. A growing imbalance between supply and demand suggests that increasingly severe water shortages may be anticipated in many areas in the near future. (Author's abstract)
W84-01145

WELLESLEY'S WATER PROGRAM PLANNING; DEMAND STRATEGY,
Massachusetts Dept. of Public Works, Wellesley Hills.
M. R. Berdan.
Journal of New England Water Works Association, Vol. 97, No. 2, p 82-89, June, 1983.

Descriptors: *Water demand, *Massachusetts, Wellesley, Public opinion, Public participation, Pricing, Regulations, Seasonal variations, Water supply development.

Two so-called 'demand strategies' have been implemented in Wellesley, Massachusetts, aimed at keeping water consumption within the same yield as the system, rather than increasing the supply of water to meet rising demands. The first strategy is seasonal, peak demand pricing and the second is a citizen education program centered around a summertime Odd-Even outdoor watering system. Both strategies stress use of simple, low cost, creative approaches to buy time, improve product reliability and enhance public image. Wellesley is primarily a residential community with about 27,000 people in 8,000 homes spread over 10 sq mi. The water supply consists of seven wells and a 143 mi distribution system with two sets of covered reservoirs with a combined storage capacity of 6.3 million gallons. The system is fully metered, with 75% of the water going to residential customers and 25% to commercial/municipal users. The current supply of 5.2 million gallons a day is not sufficient to meet present and future peak day demands. The seasonal peak demand rate begun in June of 1981 creates a sharply inverted seasonal peak demand rate structure for all customers during the period of May through September. The unit cost for peak summer consumption is substantially higher than the regular rate, thus serving as an effective deterrent against high consumption. The key to the success of citizen education efforts is public awareness, public acceptance and support, and public participation. The results thus far

achieved suggest that the water conservation and demand strategies can work and their success reflects a very large and broad based constituency. Such strategies are easily implemented, with promising long term implications. (Baker-IVI)
W84-01156

6E. Water Law and Institutions

GROUND WATER AND FEDERAL RESERVED RIGHTS,
Nevada Univ., Reno. Dept. of Civil Engineering.
J. W. Bird.
Journal of Water Resources Planning and Management, Vol. 109, No. 2, p 174-178, April, 1983.

Descriptors: *Groundwater, *Water rights, *Legal aspects, *Federal jurisdiction, Political aspects, Riparian rights, Reasonable use, *Reserved rights.

There has been a great deal of concern in the western United States regarding the concept of Federally reserved water rights. Groundwater rights, the origin of Federal powers regarding water rights, and the groundwater rights of federally reserved lands are reviewed. The Federal government may, as a landowner, use the groundwater as any other landowner, following the riparian rules of the common law of England. The federal government would not be subject to any more restrictions than any other user since it could be argued that the Federal use of water was a reasonable use for a reasonable purpose. In states that follow the appropriation doctrine the Federal government may, on or for reserved or withdrawn lands, claim a reserved groundwater right with a priority date as of the creation of the reservation. The right is limited, of course, by the amount of water available and limited to fulfill the purpose of the reservation. Any water planner must consider the reserved rights of the Federal government and recognize both there existence and the potential of a future claim of senior priority. (McKeon-IVI)
W84-01140

FEATURES OF FEDERAL LAW THAT ENCOURAGE ADOPTION OF LAND APPLICATION OF WASTEWATER,
Wisconsin Univ.-Madison. Law School.
For primary bibliographic entry see Field 5G.
W84-01143

REQUIREMENTS FOR WASTEWATER HANDLING SYSTEMS: SECOND-ROUND UPDATE,
J. O. Thaler, and P. K. Sinha.
Power Engineering, Vol. 87, No. 8, p 54-55, August, 1983. 1 Tab.

Descriptors: *Regulations, *Wastewater management, *Powerplants, Industrial wastes, Chlorination, Fly ash, Cooling water, Runoff.

The effects that the recently promulgated second-round limitations will have in the establishment of requirements for wastewater handling systems are discussed. These second-round regulations identify power plant discharge categories subject to federal limitations including once-through cooling water, recirculating cooling water system blowdown, ash transport water, chemical based metal cleaning wastes, and coal pile precipitation runoff. The limitations are specifically aimed at control of the discharge of free available chlorine, pH, total suspended solids, oil/grease, copper, iron, and polychlorinated biphenyl compounds. Specific rules for chlorination of cooling waters also are established. Because of the costs that would be associated with routine analyses to demonstrate compliance with the nondetectable discharge limit, the EPA has decided to allow the permit-issuing authority the option of accepting mass balance calculations as an alternative. (Baker-IVI)
W84-01235

6G. Ecologic Impacts Of Water Developments

INDEX OF HABITAT DISTURBANCE FOR LAKESHORE COTTAGE DEVELOPMENT,
Ontario Ministry of Natural Resources, Toronto. Wildlife Branch.
G. Racey, and D. Eueler.
Journal of Environmental Management, Vol. 16, No. 2, p 173-179, March, 1983. 4 Fig, 2 Tab, 18 Ref.

Descriptors: *Land use, *Land development, Habitats, Environmental effects, Lake shores, Vegetation effects, Runoff, Water quality.

An index is identified that can be used to quantify habitat changes resulting from lakeshore cottage development. Characteristics of cottage lots in central Ontario are also discussed. An Area Development Index (ADI) was calculated using variables obtained from the area disturbed in the ground, shrub, and tree layers. The area of disturbed habitat in the three vegetation layers varied significantly ($p<0.01$) with lot size, and the area cleared in the shrub layer was significantly larger ($p<0.05$) than that cleared in the ground or tree layer. The mean number of buildings on a lot was 2.2 (+ or - 0.9), and their mean distance from the water was 20.0 m (+ or - 12.3). These differences were not significant. Small lots (<0.2 ha) can be expected to have a large ADI value. As the lot size increases there is an expected increase in the amount of undisturbed area on the lot. The major factor affecting wildlife, runoff, or water quality is not usually the presence of the cottage itself, but the residents activities and the destruction of habitat associated with cottage construction. The defined relationship between lot size and the ADI makes it possible to predict the proportion of area disturbed by development. (McKeon-IVI)
W84-01208

TEMPERATURE DISTRIBUTION AROUND A WELL DURING THERMAL INJECTION AND A GRAPHICAL TECHNIQUE FOR EVALUATING AQUIFER THERMAL PROPERTIES,
D'Appolonia Consulting Engineers, Inc., Pittsburgh, PA.
C.-S. Chen, and D. L. Reddell.
Water Resources Research, Vol. 19, No. 2, p 351-363, April, 1983. 13 Fig, 2 Tab, 43 Ref.

Descriptors: *Thermal injection, *Heat transfer, Confined aquifers, Conduction, Convection, Mathemetical models, Thermal conductivity, Caprock, Injection wells.

Analytical solutions of temperature distribution are developed for the problem of thermal injection into a confined aquifer with a caprock of finite thickness. Heat transfer by horizontal conduction and convection within the aquifer and by vertical conduction in the caprock and bedrock is considered. Steady state and two asymptotic unsteady state solutions of temperature distribution around a thermal injection well are determined. One unsteady state solution is for short time periods and the other is for long time periods. The caprock thickness is only important in the long time period solution. A graphical technique is presented using hypothetical data for evaluating four pertinent aquifer thermal properties: (1) the horizontal thermal conductivity of the aquifer, (2) the thermal capacity of the aquifer, (3) the vertical thermal conductivity of the caprock, and (4) the thermal capacity of the caprock. Field measurements of aquifer temperatures near the steady state condition are theoretically needed to utilize the graphical technique. In many practical situations a long time period is required to achieve a steady state condition. Therefore, a modified graphical technique employing an unsteady temperature distribution is illustrated and can be used to estimate the horizontal thermal conductivity and aquifer thermal capacity. (Author's abstract)
W84-01362

SEASONAL LIMNOLOGICAL CHANGE AND PHYTOPLANKTON PRODUCTION IN OHAKURI, A HYDRO-ELECTRIC LAKE ON THE WAIKATO RIVER,
Department of Scientific and Industrial Research, Taupo (New Zealand). Div. of Marine and Freshwater Sciences.
For primary bibliographic entry see Field 2H.
W84-01372

7. RESOURCES DATA

7A. Network Design

APPLICATION OF NETWORK DESIGN PROCEDURES FOR REDESIGNING KIZILIRMAK RIVER BASIN RAINGAUGE NETWORK, TURKEY,
Middle East Technical Univ., Ankara (Turkey). Dept. of Civil Engineering.
U. Sorman, and G. Balkan.
Hydrological Sciences Journal, Vol. 28, No. 2, p 233-246, June, 1983. 6 Fig, 2 Tab, 12 Ref.

Descriptors: *Rain gages, *Network design, Rainfall distribution, *Turkey, Hydrologic data, Kizilirmak River basin.

Recently developed rainfall network design techniques are discussed and compared. Present day hydrological studies require high levels of accuracy from collected data. Also, scientists need to know the degree of accuracy of the information they use. The existing rainfall network in the Kizilirmak basin must be redesigned in order to meet the required level of accuracy preset by rainfall data users. The three following techniques were applied: optimum interpolation procedure which is a flexible method; variance of mean areal rainfall; and the analysis of variance. The existing network of 52 gauges is redesigned so that the network will have an average root mean square error (rmse) of < 32 mm and the percentage of the area with rmse > 36 mm is limited to 10%. The proposed criteria are satisfied by a network of 53 gauges of which eight were newly established and seven of the existing ones removed. (Author's abstract)
W84-01100

GROUNDWATER OBSERVATION NETWORK DESIGN FOR THE KANSAS GROUNDWATER MANAGEMENT DISTRICTS, U.S.A.,
Kansas State Geological Survey, Lawrence.
M. Sophocleous.
Journal of Hydrology, Vol. 61, No. 4, p 371-389, 1983. 9 Fig, 1 Tab, 13 Ref.

Descriptors: *Network design, *Groundwater level, Observation wells, Groundwater management, Water table, Economic aspects, Kansas.

Concerns about the efficiency and economic soundness of the Kansas groundwater monitoring program led to a systematic redesign of this network, a tentative phase of which is presented in this study. The objectives of this paper include monitoring of major aquifers within each groundwater management district at a spatially more uniform level of accuracy, elimination of redundant measurements and optimization of the information gained from each observation well. The theory of regionalized variables is employed to estimate the amount of spatial variability of the water table, on which the network design is based. This study shows that it is not practical to attempt to reduce the already existing level of uncertainty uniformly throughout the various districts; to do so would tremendously increase the cost of well monitoring, which is already very high. Assuming that the currently existing network is satisfactory for the State's objectives, a reduced network consisting of one well every 6.4 km is equally satisfactory. The reduced network yields district-wide maps that do not differ significantly from those produced using the present network and at the same time it reduces the already-existing network by 18-47%. Therefore, adoption of a rearranged square well network is recommended, which is reduced to a 6.4-km spacing to achieve both a uniform level of information about the water table and a minimum required accuracy. (Author's abstract)
W84-01216

Group 7A—Network Design

VELOCITY EQUATION FOR WATER QUALITY MODELING IN GEORGIA,
Georgia Dept. of Natural Resources, Atlanta. Environmental Protection Div.
For primary bibliographic entry see Field 5A.
W84-01277

7B. Data Acquisition

ORGANIZATIONAL NEEDS FOR HYDROLOGICAL APPLICATIONS OF SATELLITE REMOTE SENSING IN DEVELOPING COUNTRIES,
Bristol Univ. (England). Dept. of Geography.
E. C. Barrett.
Hydrological Sciences Journal, Vol. 28, No. 2, p 273-281, June, 1983. 2 Tab, 9 Ref.

Descriptors: *Remote sensing, *Satellite technology, *Hydrologic data, *Rainfall, Institutional constraints, Political constraints, *Developing countries.

Remote sensing has great, but largely unrealized, potential in operational hydrology especially in countries where conventional data are not adequate even to meet existing needs. It is argued that organizational, not physical, problems have been the most significant in limiting the spread of satellite remote sensing applications for hydrology within the developing world. Looking to the future, the relative merits of tactical ('bottom up') and strategic ('top down') approaches for the promotion of satellite remote sensing for hydrology in such areas are outlined and discussed. Existing and proposed International Hydrological Program projects may proffer some suitable channels through which significant progress could be made. (Moore-IVI)
W84-01103

WEATHER STATION SITING AND CONSUMPTIVE USE ESTIMATES,
Idaho Univ., Kimberly. Twin Falls Research and Extension Center.
For primary bibliographic entry see Field 2B.
W84-01144

USE OF HIGH HORIZONTAL RESOLUTION SATELLITE TEMPERATURE AND MOISTURE PROFILES TO INITIALIZE A MESOSCALE NUMERICAL WEATHER PREDICTION MODEL - A SEVERE WEATHER EVENT CASE STUDY,
Australian Numerical Meteorology Research Centre, Melbourne.
G. A. Mills, and C. M. Hayden.
Journal of Climate and Applied Meteorology, Vol. 22, No. 4, p 649-683, April, 1983. 19 Fig, 33 Ref.

Descriptors: *Weather forecasting, *Satellite technology, Midwestern United States, Moisture profiles, Storms, Model studies, Remote sensing, Forecasting, Prediction, Model testing.

Sub-synoptic resolution satellite-derived temperature and moisture profiles have been assimilated into a mesoscale numerical weather prediction model. This model is intended for use in forecasting the environment of organized convective storm complexes in the midwestern section of the United States. The domain of the analysis covers most of the North American continent, as well as adjacent areas of the Atlantic and Pacific Oceans. The scheme uses a combination of the successive correction method (SCM) of Cressman and the variational blending techniques of Sasaki. Two characteristics make it particularly suitable for the objective analysis of satellite temperature profiles: the geopotential thickness is a primary analysis variable, making it a wind from mass scheme, and secondly, differing weight can be given to scalar and gradient geopotential information during the variational blending procedure, thus allowing the geopotential gradient information inherent in the satellite temperature data sets to be used more effectively. Assimilation of high horizontal resolution satellite temperature data sets into a mesoscale numerical weather prediction model produced short term forecasts with a promising level of skill. The forecasts show a good level of accuracy as compared with high resolution rawinsonde data. The high horizontal resolution of the satellite data contributes to the accuracy of the forecast through the model's ability to retain details of the initialization. (Baker-IVI)
W84-01168

EVALUATION OF A DEPTH PROPORTIONAL INTAKE DEVICE FOR AUTOMATIC PUMPING SAMPLERS,
Pacific Southwest Forest and Range Experiment Station, Arcata, CA.
R. E. Eads, and R. B. Thomas.
Water Resources Bulletin, Vol. 19, No. 2, p 289-292, April, 1983. 3 Fig, 5 Ref.

Descriptors: *Intakes, *Water sampling, *Suspended sediments, Pumps, Water depth, Sampling.

A depth proportional intake boom for portable pumping samplers was used to collect suspended sediment samples in two coastal streams for three winters. The boom pivots on the stream bed while a float on the downstream end allows debris to depress the boom and pass without becoming trapped. This equipment modifies point sampling by maintaining the intake nozzle at the same proportion of water depth regardless of stage. Data taken by pumping samplers with intakes mounted on the boom were compared with depth integrated hand samples. Pumped samples showed higher concentrations than depth integrated hand samples. Results suggested that cross-sectional sampling can give high precision with proper placement and calibration of a boom mounted intake. (Author's abstract)
W84-01274

EFFECTIVE USE OF LANDSAT IN HYDROLOGIC MODELS,
National Aeronautics and Space Administration, Greenbelt, MD. Goddard Space Flight Center.
A. Rango, A. Feldman, T. S. George, III, and R. M. Ragan.
Water Resources Bulletin, Vol. 19, No. 2, p 165-174, April, 1983. 4 Fig, 5 Tab, 10 Ref.

Descriptors: *Hydrologic models, *Discharge frequency, *Satellite technology, *Cost analysis, Hydrologic cycle, Data interpretation, Land use, Remote sensing, Watersheds.

In a cooperative demonstration project, NASA and the U.S. Army Corps of Engineers (Corps) compared conventional and Landsat-derived land-use data for use in hydrologic models, and the resulting discharge frequency curves were analyzed. When a grid-based data-management system was used an a cell-by-cell basis (size about 1.1 acres or 0.45 hectare), Landsat classification accuracy was only 64%, but, when the grid cells were aggregated into watersheds, the classification accuracy increased to about 95%. When both conventional and Landsat land-use data were input to the HEC-1 model for generating discharge frequency curves, the differences in calculated discharge were judged insignificant for subbasins as small as 1.0 sq mi (2.59 sq km). For basins larger than 10 sq mi (25.9 sq km), use of the Landsat approach is more cost-effective than use of conventional methods. Digital Landsat data can also be used effectively by local and regional agencies for hydrologic analysis by incorporating the data into grid-based data-management systems. The transfer of this new technology is well under way through inclusion in some Corps training courses and through use by both county government personnel and private consultants. (Author's abstract)
W84-01291

GROWTH RESPONSE AND SPECTRAL CHARACTERISTICS OF A SHORT SPARTINA ALTERNIFLORA SALT MARSH IRRIGATED WITH FRESHWATER AND SEWAGE EFFLUENT,
Delaware Univ., Newark. Coll. of Marine Studies.
For primary bibliographic entry see Field 2L.
W84-01299

USE OF CHROMATICITY IN REMOTE MEASUREMENTS OF WATER QUALITY,
For primary bibliographic entry see Field 5A.
W84-01300

DISCRIMINATION OF GROWTH AND WATER STRESS IN WHEAT BY VARIOUS VEGETATION INDICES THROUGH CLEAR AND TURBID ATMOSPHERES,
Agricultural Research Service, Phoenix, AZ. Water Conservation Lab.
For primary bibliographic entry see Field 2I.
W84-01305

KEEPING TABS ON EXCESS CHLORINE,
C. W. Ingham.
Water Engineering and Management, Vol. 130, No. 4, p 36-38, April, 1983. 4 Fig.

Descriptors: *Pollutant identification, *Measuring instruments, *Chlorine, *Colorimetry, Wastewater treatment, Quality control, Bacteria, Disinfection.

A new on-line instrument for measuring the chlorine content in effluent - the Pump-Colorimeter Total Chlorine Analyzer - was field tested for its ability to monitor chlorine residual in a treated wastewater stream. The instrument was so named because of the way its glass colorimeter cell functions as a cylinder for the sample transport pump. The unit synchronizes reagents and sample pistons so that the DPD (N,N-diethyl-p-phenylenediamine) colorimetric chlorine reagent and buffer are added confluently to the water sample. In the optical system, light is transmitted through a focusing lens and through the reacted sample in the pump cyclinder. A second lens focuses transmitted light through a beam splitter which reflects about 10% of the light toward a color filter and reference photocell. The remaining light is transmited toward another filter and measuring photocell. The difference between the photocell output signals is conditioned electronically to provide a linear output which drives the meter and an external recorder on the analyzer dial and can be transmitted to recorders and alarm systems. The DPD indicator contains iodide and a buffer solution and develops a pink color proportional to the amount of total chlorine in a sample. Bacterial growth inhibitors prevent microbial fouling of the instrument. Since installation of the instrument, smooth, automatic monitoring has become routine at the waste treatment plant. (Baker-IVI)
W84-01319

FLUORESCENT DYE AIDS DISTRIBUTION STUDIES,
Army Environmental Hygiene Agency, Fort McPherson, GA.
D. Grasso, and R. C. Williams.
Water Engineering and Management, Vol. 130, No. 4, p 40-41 and 50, April, 1983. 4 Fig, 5 Ref.

Descriptors: *Hydraulics, *Flow characteristics, *Measuring instruments, Dyes, Dye releases, Tracers, Fluorometry.

The use of an impulse dye-tracer study as a means of evaluating flor distribution structures is described in analyses of hydraulic efficiency. Cost-effectiveness of the method is predicted on the use of readily available equipment, consisting of a fluorometer and a non-reactive dye. The procedure consists of injecting a dye into the process stream or into the flow distribution structure (FDS). Dye concentration is then measured at each effluent stream over some period of time. The resulting concentrations are plotted versus time (dye-distribution curves) and the curve integrated for each stream. A modified mass balance is then performed to evaluate the hydraulic distribution efficiency of the FDS. Dye selection is dependent upon process stream characteristics and is a critical step in the technique. The most commonly used dyes are fluorescent dyes such as Fluorescein, Pontacyl Pink B, Rhodamine B and Rhodamine WT. Once selected, the injection concentration of a dye is calculated according to the estimated flow rates. After injection, samples should be collected at regular time intervals. Aliquots of each sample are

analyzed for fluorescence intensity with a fluorometer. The relationship between fluorescence intensity and dye concentration has been shown to be linear through derivation from the Beer-Lambert-Bouger Law. Thus it is not necessary to develop a standard curve in order to measure relative aliquot dye concentrations and only fluorescence intensity need be recorded as a function of time. (Baker-IVI).
W84-01320

CONTAMINATION OF SUCCESSIVE SAMPLES IN PORTABLE PUMPING SYSTEMS,
Pacific Southwest Forest and Range Experiment Station, Arcata, CA.
R. B. Thomas, and R. E. Eads.
Water Resources Research, Vol. 19, No. 2, p 436-440, April, 1983. 4 Fig, 1 Tab, 5 Ref.

Descriptors: *Water sampling, *Suspended sediments, Monitoring, Water quality, Particle size, Sample contamination, Pumping samplers.

Automatic discrete sample pumping systems used to monitor water quality should deliver to storage all materials pumped in a given cycle. If they do not, successive samples will be contaminated, a severe problem with highly variable suspended sediment concentrations in small streams. The cross-contamination characteristics of two small commonly used portable pumping samplers are compared to each other and to reference measurements under conditions of sudden and severe changes in suspended sediment concentrations. The pressure-vacuum sampler showed greater cross contamination, especially when changing from high to zero concentrations, than the peristaltic sampler. Both samplers, however, cross-contaminated to some degree. The contamination was primarily due to the sand size particles rather than to the finer sizes. (Author's abstract)
W84-01363

7C. Evaluation, Processing and Publication

FLOOD ROUTING ON A SMALL COMPUTER,
New Mexico Univ., Albuquerque. Dept. of Civil Engineering.
R. J. Heggen.
Civil Engineering, Vol. 53, No. 3, p 63-68, March, 1983. 2 Fig.

Descriptors: *Flood routing, *Computer programs, *Flood hydrographs, *Open-channel flow, *Stage-discharge relations, Water conveyance, Computer models, Reservoir releases.

A short BASIC program has been designed for handling flood routing data on small computers. Channel hydrographs, computed by the Muskingum method, and reservoir hydrographs, calculated by the Puls procedure, are utilized for these flood routing determinations. Program data requirements also include Muskingum time constant and weighting values for channels, stage-discharge-storage rating curve coordinates for reservoirs, and a sequential listing of member confluences. This program is also suited for analyses of open channel conveyance systems, flood detention reservoirs, and combinations of the two. Flow is initialized in the model to provide steady-state continuity with initial inflows into the headwater members. The BASIC program works its way downstream in a channel and reservoir system, combining inflows at the top of each member and routing flow to the bottom. Program methodology is discussed in detail with sample programs given. (Author's abstract)
W84-01089

NATIONAL WATER-USE INFORMATION PROGRAM,
Geological Survey, Reston, VA.
W. B. Mann, IV, J. E. Moore, and E. B. Chase.
Journal of Water Resources Planning and Management, Vol. 109, No. 2, p 186-194, April, 1983. 5 Fig.

Descriptors: *Water use, *Information systems, *Data collections, Computers, Ground water, Surface water, Saline water, Consumptive use, Data acquisition, Data interpretation.

The National Water-Use Information Program is a cooperative program between the states and the Federal Government. The purpose of the program is to determine how much fresh and saline surface water and ground water is withdrawn and for what purpose, how much water is consumed during use, and how much water is returned to a water body (stream, lake, or aquifer) after use. To accomplish its purpose, the program's goals are to: (1) collect and compile water-use data; (2) develop and refine computerized water-use data systems at both the state and national levels; (3) devise new methods and techniques to improve the collection and analysis of water-use information; and (4) disseminate this information to those involved in establishing water resources policy and to those managing the resource. The program was established in 1977, when the Congress of the United States recognized the need for uniform information on water use and directed the U.S. Geological Survey to establish a program to complement the Survey's data on the availability and quality of the Nation's water resources. (Author's abstract)
W84-01142

8. ENGINEERING WORKS

8A. Structures

ZONE OF TENSILE STRESSES IN THE FOUNDATION OF A CONCRETE DAM (FROM OBSERVATION DATA),
For primary bibliographic entry see Field 8F.
W84-01067

CONSIDERATION OF THE UPLIFT PRESSURE OF WATER IN CALCULATIONS OF THE STABILITY OF CONCRETE DAMS ON ROCK FOUNDATIONS,
Yu. A. Fishman.
Hydrotechnical Construction, Vol. 16, No. 9, p 502-507, September, 1982. 4 Fig, 1 Tab, 9 Ref. Translated from Gidrotekhnicheskoe Stroitel'stvo, No. 9, p 41-44, September, 1982.

Descriptors: *Dam design, *Dam foundations, *Uplift pressure, *Concrete dams, Dam stability, Rock foundations, Stability analysis, Dam safety.

It has been suggested that the coefficient of effective area of uplift on the bottom of concrete structures (alpha 2) is different in the prelimit and limit states of structures due to the fact that in the limit state, the foundation receives disturbances such that the bounds are ruptured, crack open, and the area of contact on the surface of failure decreases. Consideration of the total of uplift, which corresponds to a state of limit equilibrium, in calculations of the stability of concrete structures of rock foundations is inadmissible and leads to results contradicting dam design and operating practice. Correct consideration of uplift and a substantial decrease of the value of the coefficient alpha 2 makes it possible to obtain higher values of the stability factors of concrete dams or to achieve for the same reliability a decrease of their cost. The coefficient of effectiveness of transmitting uplift alpha 2 under various conditions should be studied. (Moore-IVI)
W84-01069

CALCULATION OF LININGS OF A SYSTEM OF PARALLEL ROUND TUNNELS,
N. N. Fotieva, G. Ya. Gevirts, A. K. Petrenko, and A. N. Kozlov.
Hydrotechnical Construction, Vol. 16, No. 9, p 520-525, September, 1982. 3 Fig, 2 Ref. Translated from Gidrotekhnicheskoe Stroitel'sfvo, No. 9, p 53-56, September, 1982.

Descriptors: *Tunnel construction, *Pressure, *Tunnel linings, Construction, Design criteria, Powerplants, Elastic properties, Linings, Tunnels.

A method for calculating linings of two identical, mutually influencing parallel round tunnels for the action of an internal pressure based on the solution of the two-dimensional problem of elasticity theory for a medium weakened by two identical supported holes has been generalized to the case of an arbitrary number of parallel round tunnels, with centers on the same line, which can have different diameters and linings of different thicknesses made of different materials. The proposed method of calculation was used by the Leningrad Branch of the All-Union Planning, Surveying, and Scientific Research Institute when developing the specifications of tunnels for one of the hydrostations. Results of calculations are given for the section near the powerhouse (five parallel tunnels) in the construction and operating periods. The moduli of deformation of the concrete for two loaded linings were assumed reduced with consideration of the formation of cracks. Three variations of the pressures were examined for calculating the linings in the operating period. The same method can be further generalized to the case when the centers of the tunnels do not lie on the same line. (Baker-IVI)
W84-01071

THE CARSINGTON SCHEME - RESERVOIR AND AQUEDUCT,
P. G. Davey, and P. G. Eccles.
Journal of the Institution of Water Engineers and Scientists, Vol. 37, No. 3, p 215-239, June, 1983. 6 Fig, 3 Tab.

Descriptors: *Water supply development, *Reservoirs, *Aqueducts, *Pumped storage, *England, Reservoir design, Earth dams, Gravity flow, Flow augmentation.

The Carsington reservoir scheme is being developed to increase the water resources of the Severn-Trent Water Authority in the East Midlands, England. During the winter periods, water will be abstracted at the Ambergate pumping station and pumped to Carsington reservoir. In dry weather, when there is insufficient flow in the river to meet increased demand, water will be released from the reservoir and will flow by gravity to Ambergate where it will return to the river by way of the existing intake works. Water for north-east Derbyshire will be taken at Ambergate via Ogston reservoir and for the rest of the area, at Little Eaton. Provision has also been made to discharge water from the reservoir to the river Dove to augment flows to the Dove reservoirs as necessary. The dam site is unsuitable for any form of concrete dam due to the depth required for the foundations to be in unweathered strata, but is well suited for an earthfill dam, using local clays and shales. An aqueduct 10.5 km long, nearly all in tunnel, will connect the reservoir and the river Derwent. The tunnel will have a diameter of 2.3 m and will be lined with smooth bore reinforced concrete segments. The tunnels are needed to reduce the pumping head and the land disturbance and to permit gravity flow back to the river. (Moore-IVI)
W84-01075

SECONDARY FLOWS AND THEIR SIGNIFICANCE IN THE DESIGN AND OPERATION OF HYDRAULIC STRUCTURES,
For primary bibliographic entry see Field 8B.
W84-01077

OPTIMIZATION OF GRAVITY-FED WATER DISTRIBUTION SYSTEMS: APPLICATION,
Visvesvaraya Regional Coll. of Engineering, Nagpur (India).
For primary bibliographic entry see Field 8B.
W84-01106

SOME PROBABILISTIC ELEMENTS OF FIELD TESTING IN WATER DISTRIBUTION SYSTEMS,
Waterloo Univ. (Ontario). Dept. of Civil Engineering.
E. A. McBean, S. Al-Nassri, and D. Clarke.
Proceedings of the Institution of Civil Engineers, Part 2, Vol. 75, p 143-153, June, 1983. 5 Fig, 19 Ref.

Descriptors: *Water conveyance, *Mathematical models, *Pipelines, *Pressure differential, Hazen-Williams equation, Field tests, Flow discharge.

Many engineering designs for water supply networks represent extensions to existing systems, so the determination of accurate estimates of the parameters for use in a mathematical model may be difficult since in some places a considerable deviation from newly constructed conditions develops. First order analysis (FOA) principles were used to examine the sensitivity of the pressure differential across several pipes due to uncertainties in the mathematical model, diameter, discharge, hydraulic exponent, and the Hazen- Williams coefficient. This information can be used to identify when considerable uncertainty exists in estimation of the pressure drop across a pipe and thus is an indication of whether a field-testing program may be warranted. The results obtained were also used to obtain an indication of the required accuracy of measurement devices for providing meaningful results in field measurements of pressure differentials along sections of distribution mains. (Moore-IVI)
W84-01247

MANHOLE INFLOW AND INFILTRATION STOPPED WITH SPECIAL REPAIRS,
Driver, Olson-Degraff and Associates, Rockford, IL.
F. T. Driver.
Water Engineering and Management, Vol. 130, No. 4, p 31-32, April, 1983.

Descriptors: *Infiltration rate, *Sewer infiltration, *Manholes, Sealants, Grouting.

Relatively new methods of manhole rehabilitation have substantially and economically reduced inflow and infiltration into the sewer collection network of Northbrook, Illinois. Damaged or poorly fitting manhole lids were replaced. Interior manhole restoration included replacing loose brick and mortar. Interior surfaces in the system were cleaned by high-pressure water jets. A chemically active cementitious material was applied to masonry surfaces to reduct further outflow. In those manholes where leaks were relatively few, pressure-grouting was used. Chemical grouting of precast structures, waterproofing of older brick structures, and lid repairs on just 170 of the village's manholes have reduced the total system infiltration and inflow by as much as 10%. (Wheatley-IVI)
W84-01318

8B. Hydraulics

DETERMINATION OF THE CROSS SECTION OF CANAL CHANNELS FOR SEDIMENT TRANSPORT,
Kh. Sh. Shapiro.
Hydrotechnical Construction, Vol. 16, No. 9, p 498-501, September, 1982. 2 Tab, 5 Ref. Translated from Gidroteckhnicheskoe Stroitel'stvo, No. 9, p 38- 40, September, 1982.

Descriptors: *Canals, *Channels, *Sediment transport, *Silting, Slopes, Channel morphology, Discharge capacity, *USSR.

A formula for selecting the slope and cross sections of a canal channel which provides passage of the design water discharges, dynamic stability of the channel, and sediment transport is given in two forms. One is for those cases when charging of the flow with fine sediment fractions is considerably below its transport capacity, which occurs in a considerable majority of canals with an intake from the Amu Darya, Syr Darya, Kura, and other rivers. The other method is for those relatively rare cases when the flow entering the canal is charged in excess of the transport capacity with all fractions, such as the Tedzen River. The slopes obtained by using this formula, especially in the case of large discharges, are slightly less than the slope in the water source. Nonsiltation of canals when the slopes are less than the river slope is confirmed by data from the Sukkur hydrodevelopment. (Moore-IVI)
W84-01068

HYDRAULIC MODELING TODAY,
A. M. Prudovskii.
Hydrotechnical Construction, Vol. 16, No. 9, p 508-519, September, 1982. 5 Fig. Translated from Gidrotekhnicheskoe Stroitel'stvo, No. 9, p 47-53, September, 1982.

Descriptors: *Conferences, *Hydraulic models, Fluid mechanics, Computers, Channels, Erosion, Cavitation, Reynolds number, Froude number, Model studies, Hydraulics.

At the 19th Congress of the International Association of Hydraulic Research, 72 reports were offered at session D, Hydraulic Research and Modeling Techniques. The papers fitted into the following categories: criteria of correspondence of model and prototype; modeling in the case of several characteristic dimensionless numbers, e.g. Froude and Reynolds; new laboratory modeling techniques; new achievements in the area of instruments for laboratory and prototype investigations; and digital and analog computers as laboratory equipment. The problem of combining hydraulic (physical) and numerical modeling in hydraulic research was examined, bearing in mind that in both cases reference is to the solution of the problem by the modeling method with the use of different means. The selection of the modeling method in each specific case is determined by many circumstances, with the basic limitations of the possibility of their use being paramount. Attention was also given to the correspondence of the roughness of the stream channel on the model and prototype and to a problem related to distortion of the geometric scales. The effect of Re number on the discharge characteristic of a measuring flume was reported. The selection of the time scale of channel deformations and schematization of a transient hydraulic regime were studied. Cavitation erosion, groundwater flow measurements, discharge of warm water, new measuring instruments and methods, and use of a digital computer as a means of controlling an experiment were each reported on at the conference. A list of session D reports and authors is provided as an appendix to the review. (Baker-IVI)
W84-01070

EXWICK FLOOD RELIEF CHANNEL HEADWORKS,
M. C. Harries.
Journal of the Institution of Water Engineers and Scientists, Vol. 37, No. 3, p 243-250, June, 1983. 4 Fig, 1 Ref.

Descriptors: *Flood control, *Radial gates, *Bed load, Channels, Hydraulic design, Flow controls, Model studies, Accretion.

The Exeter Flood Protection Scheme was promoted in the early 1960s to protect the low lying parts of the city from a recurrence of the serious floods of 1960. A design was developed for the works at the head of the relief channel which controlled the distribution of flow between the river channel and the relief channel. Model studies indicated that when the flood flow was at the estimated formative discharge, 3,700 cusec would be discharged to the relief channel, leaving only 4,300 cusec in the river channel downstream from the headworks. The whole of the bed load would probably remain in the river channel, but the greatly reduced flow would be unable to carry it forward, and considerable accretion would take place. The capacity of the river channel could be increased to 9,000 cusec by raising the right bank. Calculations showed that a structure consisting of a central unrestricted flume 32 ft wide flanked on each side by a radial gate 34 ft wide could be operated to give the ideal distribution of all flows up to the design flood. The headworks have been constructed in accordance with the design and have operated up to about half the design flood. (Moore-IVI)
W84-01076

SECONDARY FLOWS AND THEIR SIGNIFICANCE IN THE DESIGN AND OPERATION OF HYDRAULIC STRUCTURES,
D. H. Simm.
Journal of the Institution of Water Engineers and Scientists, Vol. 37, No. 3, p 251-256, June, 1983. 8 Fig.

Descriptors: *Fluid mechanics, *Hydraulic design, *Viscosity, Weirs, Piers, Sluices, Gates, Vortices, Boundary layers.

Secondary flow phenomena often cause difficulties in the smooth operation of hydraulic structures which could have been overcome during design. This may result because basic equations in fluid mechanics do not strictly apply to real fluids, which possess viscosity, and the departures from theory are largely due to this fact. In many cases, the variation from ideal behavior may be small or can be allowed for by the application of a simple coefficient. In other cases, secondary effects are significant. Viscosity, the boundary layer, vorticity, and the vortex effect should all be taken into consideration in the design of hydraulic structures. Secondary flow effects are difficult to model satisfactorily because viscous criteria determine the degree of turbulence induced. An investigation into local effects may require a model of a small part of the scheme to a larger scale. Practical situations to which these factors should be applied include: discharge under a control gate, discharge over a compound weir, the approach to a divided pier, and tunnel and sluiceway entries. (Moore-IVI)
W84-01077

CONSERVATISM OF PROBABLE MAXIMUM FLOOD ESTIMATES,
Harza Engineering Co., Chicago, IL.
B.-H. Wang, and R. W. Revell.
Journal of Hydraulic Engineering, Vol. 109, No. 3, p 400-408, March, 1983. 7 Tab, 14 Ref.

Descriptors: *Design floods, *Maximum probable floods, Safety engineering, Hydraulic design, Dam construction, Spillways, Safety, Flood control, Precipitation, Design criteria, Floods.

Depending on the assumptions and data used in the analysis, a probable maximum flood (PMF) estimate can vary over a significant range of values, each associated with a certain degree of conservatism. A procedure is presented to determine the relative conservatism of a PMF estimate which will then enable engineers to determine how the PMF should be used in designing structurally safe major dams and spillways. The procedure consists of assigning an index value for each factor involved in the PMF estimate. Within the range for each factor, the index value is selected such that the higher values reflect greater conservatism. Among the factors, the values are selected such that they properly reflect the relative effect of the factors on the PMF. The overall conservatism of an estimate is then measured by the sum of the individual index values. Of all the factors, PMP (Probable Maximum Precipitation) is the most important. To demonstrate potential application of the concept, an example is given for a hypothetical PMF estimate. If the estimated PMF has a total index value of well over 100, consideration should be given to designing the structure for a smaller flood unless there are reasons for an unusually conservative design. If the total index value is well below 100, the design engineer should provide necessary safety factors to ensure the safety of the structure. (Baker-IVI)
W84-01097

MOVEMENT OF FINE GRAINS IN THE VICINITY OF WELL SCREENS,
Vizgazdalkodasi Tudomanyos Kutato Intezet, Budapest (Hungary).
G. Kovacs, and L. Ujfaludi.
Hydrological Sciences Journal, Vol. 28, No. 2, p 247-260, June, 1983. 8 Fig, 2 Tab, 12 Ref.

Descriptors: *Soil suffosion, *Flow rate, Well screens, Particle size, Velocity.

A great number of laboratory experiments have been performed to study the flow generated suffosion process in soil samples supported by perforated screens. Both parallel and radial flow were

tested (a typical example of the latter is a well-screen supporting the material of an aquifer). The soil samples tested were theoretically divided into two parts: a coarse grained fraction which behaves as a self-supporting skeleton, and a fine-grained fraction filling the pores of the skeleton. Experimental results showed that the process of soil suffosion occurs with increasing flow velocity. At low velocities the fine grains maintain their original position and the flow can be described by Darcy's law. Reaching a critical velocity vc1 the fine grains start to move, partially plugging the pores of the skeleton, while resistance of the sample is increasing. Reaching a second critical flow velocity vc2 results in the development of microchannels, through which fine grains may move out from the layer. The quantity of these fine grains depends on the composition of the soil sample, the flow rate and the slot-diameter of the well-screen. On the basis of the experimental results empirical formulae have been developed for calculating the critical velocities vc1 and vc2, and the optimum slot sizes of the screen. (Author's abstract)
W84-01101

OPTIMIZATION OF GRAVITY-FED WATER DISTRIBUTION SYSTEMS: APPLICATION,
Visvesvaraya Regional Coll. of Engineering, Nagpur (India).
P. R. Bhave.
Journal of Environmental Engineering, Vol. 109, No. 2, p 383-395, April, 1983 2 Fig, 5 Tab, 7 Ref.

Descriptors: *Water distribution, *Optimization, *Gravity flow, *Linear programming, Systems analysis, Water conveyance.

A method for the optimal design of multisource, looped, gravity-fed water distribution systems subjected to a single loading pattern is illustrated through a design example. The proposed methodology uses linear programming (LP) techniques for two different purposes. Initially, an LP problem similar to the classical transportation problem is formulated and solved to obtain the design distribution graph. This system is then optimized by successively formulating (if necessary) and solving an LP problem for obtaining the locally optimal solution. Two node labeling procedures have been introduced in the suggested methodology. This is especially done to develop the expressions for the various design feasibility constraints. The transportation problem technique yields a unique design distribution graph. Once the design distribution graph is obtained, the nonprimary links are located. Though the reliability of distribution increases, the cost of the network also slightly increases. (Wheatley-IVI)
W84-01106

SHOALING PROCESSES IN NAVIGABLE WATERS,
American Society of Civil Engineers, New York. Task Committee on Causes and Effects of Shoaling in Navigable Waters.
R. Ariathurai, J. Golden, Jr., W. H. McAnally, Jr., G. A. Stout, and J. Neiheisel.
Journal of Waterway, Port, Coastal and Ocean Engineering, Vol. 109, No. 2, p 199-221, May, 1983. 4 Fig, 3 Tab, 44 Ref.

Descriptors: *Estuaries, *Shoals, *Navigable waters, *Waterways, Sedimentation, Harbors, Hydrodynamics, Physicochemical processes, Sediment transport, *Shoaling processes.

Sedimentation processes in our nation's waterways and harbors are controlled by a complex array of physical and chemical factors that are known only in general terms. Evaluation of hydrodynamic processes and identification of null points are the most useful methods in predicting shoaling in navigation channels. Physicochemical processes controlling sedimentation are complex interactions of suspended solids and water chemistry which are in the early stages of infancy in respect to our understanding and interpretation. Because the bulk of coastal zone dredging occurs in estuaries, and since shoaling process concepts for estuaries can be applied to upstream and coastal areas, this study is concentrated on the shoaling processes common to estuaries. The estuary itself is a major source of shoaling material, perhaps even the primary source in many cases. Estuaries are sediment traps that are gradually filling with sediment. Manmade modifications can dramatically alter shoaling patterns by changing either the depositable sediment supply or the transport capacity. (Moore-IVI)
W84-01130

SEDIMENT SUSPENSION WITH RIPPLED BED,
Saitama Univ. (Japan). Dept. of Foundation Engineering.
S. Ikeda, and T. Asaeda.
Journal of Hydraulic Engineering, Vol. 109, No. 3, p 409-423, March, 1983. 13 Fig, 3 Tab, 11 Ref.

Descriptors: *Ripple marks, *Sediment suspension, *Turbulent flow, Vortices, Entrainment, Model studies, Eddies, Water currents, Statistical analysis.

Experiments on the suspension of sediment were performed in a flume with and without a sediment layer on the bottom. For movable bed runs, three-dimensional sand ripples were found to seriously affect the features of the suspended sediment. The horseshoe vortices and the resulting bursts in the lee of the ripples intermittently entrain a large amount of sediment into the outer layer of flow. Details of the suspension process were studied using a sand ripple model made of plaster. The result revealed that the vertical component of turbulent eddies is responsible for the suspension of sediment, and that the component is statistically described by the Gaussian distribution. The statistical distribution of the concentration fluctuation was observed to be highly skewed, and the reason was determined to be the fact that the concentration increases to the power of eight against the vertical fluid velocity. The period of the intermittent ejection of sediment agreed reasonably with those reported for natural geophysical flows. Thus, the suspension of sediment in flows with rippled beds was proven to be significantly correlated with bursting phenomenon behind sand ripples. (Moore-IVI)
W84-01131

DIFFERENCE METHODS OF FLOW IN BRANCH CHANNEL,
Academia Sinica, Shanghai (China). Shanghai Inst. of Computer Technology.
Z.-C. Li, L.-J. Zhan, and H.-L. Wang.
Journal of Hydraulic Engineering, Vol. 109, No. 3, p 424-446, March, 1983. 11 Fig, 7 Ref.

Descriptors: *Unsteady flow, *Branch channels, Tidal rivers, Flow characteristics, Channels, Flood flow, Mathematical studies, Hydraulic equations, *Yangtse River Branch Channel.

With the development of river transportation and water conservation construction, unsteady flows in branching channels need to be calculated frequently. A study was made of the methods of calculation. In order to compute the unsteady flow in a channel without branching, non-equidistant difference schemes on interior mesh points and the corresponding difference schemes on boundary mesh points have been developed. The branching of channels is a usual natural phenomenon. The Stoker method can be applicable only to the simple circumstance when the branch-point is basically stationary. In fact, the branch point of tidal river (or some inland rivers) is movable within a somewhat large area depending on the variation of tide height (or flood height). For the movable branch point, implicit and semi-implicit methods are provided. Both methods have already found their use in practical problems. (Moore-IVI)
W84-01132

UNIFORM REGION OF SELF-AERATED FLOW,
Canterbury Univ., Christchurch (New Zealand).
I. R. Wood.
Journal of Hydraulic Engineering, Vol. 109, No. 3, p 447-461, March, 1983. 11 Fig, 14 Ref.

Descriptors: *Spillways, *Aeration, Slopes, Velocity, Entrainment, Friction, Air concentration.

The measurement of air concentration and velocity obtained in the laboratory are compared with the recent prototype measurement obtained on Aviemore spillway. This comparison suggests that if a characteristic depth such as the depth at which the air concentration is 0.9 is chosen then the averaged air concentration over this depth is only a function of the slope. Similarly the air concentration distribution is also determined by the slope. The velocity distribution determined in the laboratory and in the field are also compared and it is suggested that water velocity measurements are consistent with a universal velocity distribution. These with the Darcy friction factor computed from laboratory results lead to a simple method for predicting the design parameters in the uniform aerated flow at the end of a long spillway. (Author's abstract)
W84-01133

FLOW NEAR GROIN-LIKE STRUCTURES,
Alberta Univ., Edmonton. Dept. of Civil Engineering.
N. Rajaratnam, and B. A. Nwachukwu.
Journal of Hydraulic Engineering, Vol. 109, No. 3, p 463-480, March, 1983. 8 Fig, 1 Tab, 16 Ref.

Descriptors: *Groins, *Turbulent flow, *Hydraulic models, Velocity, Deflection, Flow control, Model studies, Shear stress.

This paper presents the results of an experimental study on the structure of turbulent flow near groin-like structures. Based on experimental observations, the deflected flow has been analyzed using the model of the three-dimensional turbulent boundary layer. The flow bounded by the separating stream line, the groin, and the adjacent bank has been analyzed by treating it as a shear layer in which the velocity profiles have been found to be similar. The amplified bed shear stress near the groin has also been analyzed using the similarity idea. Even though the majority of the present experiments were done with the thin-plate groin, some observations were also made on a groin with a semicylindrical nose. (Author's abstract)
W84-01134

CLEAR-WATER SCOUR AT CYLINDRICAL PIERS,
Auckland Univ. (New Zealand).
A. J. Raudkivi, and R. Ettema.
Journal of Hydraulic Engineering, Vol. 109, No. 3, p 338-350, March, 1983. 8 Fig, 1 Tab, 8 Ref.

Descriptors: *Piers, *Scour, *Particle size, Bridges, Sediment transport, Bed sediment, Sediment erosion.

The results of laboratory experiments on the clear-water local scour of cohesionless bed sediment at cylindrical bridge piers are presented. The equilibrium depth of clear-water local scour is related to the grading of the bed sediment. In general, as the geometric standard deviation of the particle size distribution increases, the equilibrium scour depths decrease. The equilibrium depth of local scour decreases with the decreasing relative size of pier diameter to mean bed particle size for values less than about 20 to 25. The maximum equilibrium depth of clear-water local scour is a function of the relative depth (depth of flow/pier diameter) and the relative size (pier diameter/mean particle size). The equilibrium depth of local scour decreases at a greater rate with decreasing flow depth for smaller values of the relative flow depth. The decrease in the equilibrium depth is caused by to the interference of the water surface roller formed around the pier with the downwards flow into the scour hole. (McKeon-IVI)
W84-01138

CHANNEL MIGRATION AND INCISION ON THE BEATTON RIVER,
Wollongong Univ. (Australia). Dept. of Geography.
G. C. Nanson, and E. J. Hickin.
Journal of Hydraulic Engineering, Vol. 109, No. 3, p 327-337, March, 1983. 6 Fig, 1 Tab, 7 Ref.

Descriptors: *Bend migration, *Channel migration, Channel erosion, Flood plains, Forest succession, Channel width, Beatton River, *British Columbia.

New field data relating to bend migration rates with bend radius of curvature to channel width ratios (r sub m /w) for the Beatton River in British Columbia confirm the form of the relationship previously described, although there is more variance than initial results suggested. Recent data from forest successions on the floodplains of a variety of migrating rivers show that channel migration is a discontinuous process within any single bend. This means that predictions of migration rates for individual bends, based on short-term measurements using erosion pins or aerial photographs, are highly suspect. These variations in migration rate are likely a response to fluctuating channel widths over time because of a short-term imbalance between the rate of cutbank erosion and the rate of point-bar sediment accumulation. Finally the examination of new evidence of channel incision on the Beatton River shows that the river is downcutting at a rate of about 2 mm/yr, not at 10 mm/yr as reported earlier. (Moore-IVI)
W84-01139

WAVES IN MEANDERING STREAMS,
Michigan Univ., Ann Arbor.
C.-S. Yih.
Journal of Fluid Mechanics, Vol. 130, p 109-121, 1983. 2 Fig, 9 Ref.

Descriptors: *Wave propagation, *Stationary waves, Meanders, Spillways, Open channels, Froude number, Free surfaces, Mathematical models, Water depth.

Open water transport channels in mountainous regions often wind along contour lines of the terrain, and it has been observed that at a certain speed of flow waves of large amplitude form. Also, at the entrance of dam spillways, the contraction may create violent diamond pattern waves. Hence waves in meandering streams or in channels of variable width are of practical importance. Free-surface and internal stationary waves in a meandering stream are treated, and analytical solutions given. For each category there is an infinite number of Froude numbers, depending on the wavenumber of the meander, at which resonance occurs, and the amplitude of one of the wave components becomes infinite, according to the linear theory. These critical Froude numbers are interpreted physically. Variable depth is treated for the case of free-surface waves, and it is shown how the eigenvalues of a singular differential equation can be found under the requirement that the eigenfunction be non-singular. An attempt is made to explain the self-induced, non-stationary waves in water flowing between corrugated vertical walls, by an instability mechanism previously proposed. There is strong evidence that this mechanism is at work, at least when a sloshing mode is involved in the wave-triad interaction. (Moore-IVI)
W84-01239

STEADY SHALLOW FLOW OVER CURVED BEDS,
Asian Inst. of Tech., Bangkok (Thailand).
N. S. Sivakumaran, T. Tingsanchali, and R. J. Hosking.
Journal of Fluid Mechanics, Vol. 128, p 469-487, 1983. 12 Fig, 3 Tab, 11 Ref.

Descriptors: *Shallow flow, *Bed curvature, Critical flow, Froude number, Steady flow, Model studies, Mathematical models, Free surfaces, Bed pressure.

The validity of recent shallow-flow equations with bed curvature is examined. Subcritical, critical and supercritical steady-flow solutions are identified, and the point of critical flow on the bed located, in terms of a generalized Froude number. Experiments on steady flow over both a symmetric and unsymmetric bed profile show that the theory satisfactorily predicts the free-surface and bed-pressure profiles over -2 < or approximately = kh < or = 0.54 (where k is the bed curvature and h is the flow depth normal to the bed). (Author's abstract)
W84-01240

SETTLING QUIETS THE STORM EFFECTS,
Finkbeiner, Pettis and Strout Ltd., Toledo, OH.
G. G. Nixon, and G. L. Hoffman.
Water Engineering and Management, Vol. 130, No. 4, p 29-30, April, 1983.

Descriptors: *Clogging, *Filter media, *Storm water, *Silt load, Ohio, Water treatment facilities, Clarification, Lake Erie, Sedimentation basins.

On December 2, 1974, a severe storm swept across Sandusky, Ohio, on the south shore of Lake Erie. Sediment-laden runoff waters clogged the treatment facility, and the runs for the 12 filters were reduced to three hours. As a result of this occurrance, Sandusky began the construction of pre-sedimentation basins or tanks. Two aluminum dome-covered above-ground pre-sedimentation basins or tanks, each with a 100 foot inside diameter and providing 18 feet of water depth, were constructed. A three story Quick Mix building was built between them. Water is now pumped from the lake to this structure by a new variable frequency vertical turbine pump and an older, previously installed variable-speed pump, each with a capacity of 11.25 mgd. Raw lake water is flash-mixed with liquid alum in the Quick Mix facility and then transferred to the pre-sedimentation basins. These basins, operating in parallel, are of the flocculator-clarifier type, and additional mixing takes place within their skirts. Sludge settles to the bottom of the tanks and is discharged into sludge lagoons on the treatment plant site. The clarified water flows by gravity to the plant for further sedimentation and filtration. Now, during storm events when turbidity becomes extremely high, much of the excess solids immediately drop into the pre-sedimentation tanks, thus preventing the existing water treatment and filtration plant from being clogged. In addition, the media in six of the 12 existing filters was replaced. The pre-sedimentation project was completed in 1980, 26 months after construction began, at a total cost of 2.6 million dollars. (Wheatley-IVI)
W84-01317

FLUORESCENT DYE AIDS DISTRIBUTION STUDIES,
Army Environmental Hygiene Agency, Fort McPherson, GA.
For primary bibliographic entry see Field 7B.
W84-01320

8C. Hydraulic Machinery

WAYS TO INCREASE THE EFFICIENCY AND RELIABILITY OF OPERATING HYDROELECTRIC STATIONS WITH MULTIPURPOSE RESERVOIRS,
M. P. Fedorov.
Hydrotechnical Construction, Vol. 16, No. 9, p 479-483, September, 1982. 3 Fig, 1 Tab, 3 Ref. Translated from Gidrotekhnicheskoe Stroitel'stvo, No. 9, p 16-18, September, 1982.

Descriptors: *Reservoir operation, *Multipurpose reservoirs, *Hydroelectric plants, *Multivariate analysis, *Competing use, Water use, Long-term planning, Water management.

The operating regimes of hydroelectric stations with multipurpose reservoirs undergo considerable changes with time, which should be taken into account during design. In practice, it is very complicated to assess the changes in the regimes of water resources use for a particular reservoir more than 5-10 yr in the future. At present, about 20-25% of the installed capacity at hydroelectric stations is not used for a number of reasons, including 8-10% due to unplanned nonpower use in water-management systems. Intensification of nonpower water use substantially restricts the regimes of water energy use at stations with multipurpose reservoirs. It is necessary to conduct broad investigations of prospective operating regimes of such hydroelectric stations based on a multifactor analysis of the water use conditions. It is expedient to examine new prospective operating regimes aimed at improving the quality and reliability of the power supply with the use of the installed capacity under conditions of reduced firm output from multipurpose reservoirs. Technical and economic substantiation of prospective regimes should be based on the development of organizational and technical measures to maintain and provide reliability and efficiency of operation of the hydroelectric station under more complex conditions of operation. (Moore-IVI)
W84-01065

VIBRATION OF HYDRAULIC GATES,
J. Lewin.
Journal of the Institution of Water Engineers and Scientists, Vol. 37, No. 2, p 165-179, April, 1983. 10 Fig, 30 Ref.

Descriptors: *Hydraulic gates, *Vibrations, *Hydraulic design, Turbulent flow, Flow characteristics, Seal leakage, Flow attachment.

Causes of flow-induced vibration in gates include: seal leakage; flow attachment, shifting of the point of flow attachment, and hydraulic downpull forces; roller and turbulent flow downstream of a gate; unstable flow through small openings; flow over and under the leaves of a gate; unstable flow approach in open channels due to changes in flow from three to two dimensional conditions; unstable control systems; instability due to lack of venting and to two phase flow; problems associated with reversed tainter gates or culvert valves; slack in guide channels, pivots, guide wheels, hoist chains etc.; and the proximity of two gates. Design guidelines are presented for each of these cases. Information obtained from technical papers, model tests, observations and analysis should be taken into account in designing gates and associated civil engineering works. The main emphasis should not be placed on strengthening a vibrating structure but on creating hydrodynamic conditions and on improving the hydraulic design of the structure or of the whole installation. (Moore-IVI)
W84-01074

WHAT YOU SHOULD KNOW ABOUT FLOWMETERS,
Sparling Instruments Co., Inc., El Monte, CA.
C. W. Dean.
Water Engineering and Management, Vol. 130, No. 6, p 38-40, June, 1983. 2 Fig.

Descriptors: *Flowmeters, Measuring instruments, Gages, Wastewater facilities, Water treatment facilities.

While flow meter technology has advanced greatly in recent years, there are limitations of each design which should be known to the user. Venturi and other differential producing flow meters operate according to Bernoulli's Theorem. The accuracy of the primary device is good, over a reasonable range. However, it is inferential and produces a differential pressure and does not measure velocity directly. The secondary devices used to interpret the differential pressure as velocity cause accuracy degradation limiting the rangeability. These devices are sensitive to flow profile as anything which changes upstream velocity distribution or downstream vena contracta causes significant errors. Partial or total plugging of pressure taps creates substantial errors and maintenance problems. In propeller meters the minimum flow range is limited by the starting friction of the mechanism. Maximum flow ranges are limited to such rotational speeds that permit long life. Propeller meters are good flow profile averagers due to the large percentage of the cross-sectional area of the conduit intercepted by the propeller. Transmissive ultrasonic flow meters use difference frequency technology. Flow profile conditions in which a disproportionate amount of the liquid passes around this pressure pulse path between the two transceivers will cause low readings. Doppler Ultrasonic flow meters are strongly dependent on velocity profile and the liquid must have particles in suspension in order to operate. (Baker-IVI)
W84-01327

8D. Soil Mechanics

PROBABILISTIC UPDATING OF PORE PRESSURE FIELDS,
Massachusetts Inst. of Tech., Cambridge.
W. Hachich, and E. H. Vanmarcke.
Journal of Geotechnical Engineering, Vol. 109, No. 3, p 373-387, March, 1983. 9 Fig, 3 Tab, 16 Ref. NSF grant PFR-7815898.

Descriptors: *Pore pressure, *Earthworks, *Seepage, Mathematical models, Earth dams, Dam stability.

The performance of many earth structures is strongly conditioned by pore pressure. A first-order second-moment method is proposed to quantify uncertainty about steady-state pore pressures originating in random spatial variability of soil permeabilities. A Bayesian framework for systematic interpretation of piezometer observations is set out, which allows updating of the pore pressure field and, therefore, of geotechnical performance predictions. A probabilistic quantification of the observational method is attempted, so that probabilities assigned to different hypotheses (states of nature) regarding seepage can also be updated on the basis of piezometer readings. Application of the approach to the decision problem of sequential instrument location is suggested. The model was applied to a typical cross-section of a hypothetical earth dam. (Moore-IVI)
W84-01080

CENTRIFUGAL MODELING OF SOIL LIQUEFACTION SUSCEPTIBILITY,
California Univ., Davis. Dept. of Civil Engineering.
K. Arulanandan, A. Anandarajah, and A. Abghari.
Journal of Geotechnical Engineering, Vol. 109, No. 3, p 281-300, March, 1983. 17 Fig, 4 Tab, 23 Ref.

Descriptors: *Earthquakes, *Pore pressure, *Soil liquefaction, *Shear, Soil mechanics, Model studies, Mathematical models, Sand, Soil water.

Centrifugal model tests were conducted on a column of sand confined by a stack of teflon coated aluminum rings with a latex membrane between the sand and the rings. Dynamic centrifugal model testing was performed in a 1 m radius Schaevitz centrifuge using a piezoelectric shaker. A column of Monterey 0 grade sand contained a stacked-ring apparatus modelled a sand layer. The sand layer was instrumented with pore pressure transducers at different depths and accelerometers at the base and top. The model was excited at the base with sinusoidal motions of various amplitudes and the excess pore water pressures and the ground surface accelerations were monitored. The principal objectives were to study the generation and dissipation of excess pore water pressures, and to estimate the threshold peak ground surface acceleration, and the threshold shear strain necessary for the initiation of excess pore water pressure. The influence of prior strain history on the generation of pore water pressure was an additional objective of this study. The measured time history of excess pore pressure generation and pore water pressure distribution with depth compared favorably with that predicted by the currently available numerical procedures using dynamic test results obtained on small elements of homogeneous sand. The significance was shown of the initial prior strain history on pore pressure development and the accuracy of the peak threshold acceleration and shear strain estimated from dynamic tests on small elements of homogeneous sand in cyclic triaxial tests. (Moore-IVI)
W84-01081

CENTRIFUGAL MODELING OF TRANSIENT WATER FLOW,
Army Engineer Waterways Experiment Station, Vicksburg, MS.
K. W. Cargill, and H.-Y. Ko.
Journal of Geotechnical Engineering, Vol. 109, No. 4, p 536-555, April, 1983. 11 Fig, 5 Tab, 15 Ref.

Descriptors: *Model studies, *Earthworks, *Embankments, *Flow, Pore pressure, Drawdown, Headwaters, Transient flow, Flow rates.

The phenomenon of transient water flow in earth embankments is examined. State-of-the-art solution techniques and their shortcomings are outlined. It is hypothesized that better solutions are obtainable through centrifugal modeling of the process. An experimental program is described. In order to interpret the experimental results, theoretical scaling relations for quantities pertinent to transient water flow are developed through consideration of the basic independent variables governing the flow. Testing was conducted on a geotechnical centrifuge in a container specially constructed for the test series. Acceleration levels of 25 g, 37.5 g, and 50 g were used. Pore pressures were measured and recorded during the transient rise and fall of the headwaters by four miniature pressure transducers. From these data, histories of total head as a function of time and equipotentials during headwater rise and drawdown are plotted. Steady state flow rates are also measured. Analysis of the data leads to the conclusion that theoretical scaling relations are valid and that this method does indeed give a better understanding of the phenomenon of transient flow and may be useful in design practice. (Author's abstract)
W84-01084

LIQUEFACTION SITES, IMPERIAL VALLEY, CALIFORNIA,
Geological Survey, Menlo Park, CA.
T. L. Youd, and M. J. Bennett.
Journal of Geotechnical Engineering, Vol. 109, No. 3, p 440-457, 13 Fig, 1 Tab, 16 Ref.

Descriptors: *Liquefaction, *Earthquakes, *Sand, Soil types, Sediments, Sand boils, Channels, Earthquake engineering, Soil physical properties, California, Imperial Valley.

Sands that did and did not liquefy at two sites during the 1979 Imperial Valley, California, earthquake (magnitude 6.6) are identified and their properties evaluated. From cone soundings, stratigraphy was determined, soil types and properties estimated, and optimal locations for samples and standard penetration tests (SPT) selected. Samples were used to classify sediments and to identify modes of deposition. SPT tests were used to evaluate liquefaction susceptibility. Loose fine sands in an abandoned channel liquefied and produced sand boils, ground fissures, and a lateral spread at the Heber Road site. Evidence of liquefaction was not observed over moderately dense over-bank sand east of the channel nor over dense point-bar sand to the west. Standard analyses predict that both the channel and the over-bank sands are liquefiable, but that the point bar is resistant. At the River Park site, a layer of loose floodplain silty sand overlies a layer of clay, which in turn overlies a thick bed of sand that increases in density with depth. Parts of both the upper silty sand and lower sand liquefied and produced hundreds of sand boils. Standard analyses predict that the looser parts of both layers are liquefiable. (Moore-IVI)
W84-01098

8F. Concrete

ZONE OF TENSILE STRESSES IN THE FOUNDATION OF A CONCRETE DAM (FROM OBSERVATION DATA),
V. N. Durcheva.
Hydrotechnical Construction, Vol. 16, No. 9, p 487-492, September, 1982. 2 Fig, 6 Ref. Translated from Gidrotekhnicheskoe Stroitel'stvo, No. 9, p 32-35, September, 1982.

Descriptors: *Concrete dams, *Dam foundations, *Tensile strength, Gravity dams, Dam construction, Buttress dams, Seepage, Drainage, *USSR.

The occurrence of a zone of tension under the upstream face from operating loads is possible mainly in high gravity dams of a compressed profile constructed on a rigid foundation. Predicted decompression was confirmed by observation data for the Bratsk and Ust'-Ilim dams. The actual boundaries of the zone of decompression differ from those calculated, due to the effects of numerous technological factors during construction of the dams, which created additional compression or tension in the contact zone. One cause of the increase in the actual zone of decompression, compared to the calculated values, in the sections of the Bratsk dam was the incomplete solidity of the profile when filling of the reservoir began. At the Ust'-Ilim dam, maximum boundaries of decompression higher than those calculated were recorded in the powerhouse sections that absorbed the rise of the upper pool level of an offset profile. In buttress dams, according to the calculations, a zone of decompression should occur. Disturbance of the continuity in the contact plane was not recorded at the Andizhan dam at the normal pool level; at the Kirovskoe dam, under incomplete hydrostatic load, opening of the contact joint occurred, as a consequence of disturbance of the solidity of the contact concrete due to cracking. Compression of the upstream face and contact plane in dams sectioned into columns or elements can reduce the zone of biaxial tension. A reduction in the seepage pressure may lessen the unfavorable consequences of a decompressed foundation. In poorly permeable rocks, draining the foundation can considerably reduce uplift. (Moore-IVI)
W84-01067

CONSIDERATION OF THE UPLIFT PRESSURE OF WATER IN CALCULATIONS OF THE STABILITY OF CONCRETE DAMS ON ROCK FOUNDATIONS,
For primary bibliographic entry see Field 8A.
W84-01069

8G. Materials

INFLUENCE OF SUBSTRATUM WETTABILITY ON ATTACHMENT OF FRESHWATER BACTERIA TO SOLID SURFACES,
Warwick Univ., Coventry (England). Dept. of Environmental Sciences.
For primary bibliographic entry see Field 5D.
W84-01053

CARBONATE DEPOSITS IN VACUUM PUMPS OF O'NEILL PUMPING PLANT, CALIFORNIA,
Water and Power Resources Service, Sacramento, CA.
For primary bibliographic entry see Field 3C.
W84-01059

A CELL TO STUDY CORROSION OF MATERIALS IN THE WATER SUPPLY INDUSTRY,
Surrey Univ., Guildford (England). Dept. of Metallurgy and Materials Technology.
R. Walker, and R. J. Oliphant.
Journal of the Institution of Water Engineers and Scientists, Vol. 37, No. 2, p 143-150, April, 1983. 5 Fig, 2 Tab, 6 Ref.

Descriptors: *Corrosion, *Water conveyance, Galvanic cell, Solder, Lead, Tin, Copper, Pipes, Contamination, Corrosion control, Hydrogen ion concentration.

A galvanic cell was developed to study the corrosion that occurs when two metals or alloys are joined together and immersed in an electrolyte. The current that flows through the external circuit is used to calculate the rate or intensity of corrosion in static or flowing solutions. Data obtained in a study of solder show that the galvanic corrosion current for lead connected to a copper cathode is much higher than when tin is used. The value for a lead-tin solder anode is intermediate. The effect of the pH of the solution can also be determined and results show that for solder the galvanic current decreases as pH increases. Polarization diagrams can be used to indicate the maximum corrosion current density. Thus, the use of corrosion inhibitors to affect the rate controlling step can then be investigated with this cell. Sodium sulfate appears to act as an anodic corrosion inhibitor because it

affects the anodic curves and decreases the corrosion current from about 15 to 2 microA. The cell is useful in predicting the corrosion that may arise with different combinations of metals and alloys as well as various water conditions. (McKeon-IVI)
W84-01072

RECENT INVESTIGATIONS OF THE EPOXY RESIN LINING OF WATER MAINS,
WRC Engineering, Swindon (England).
R. W. Parkinson, I. C. Warren, and K. J. North.
Journal of the Institution of Water Engineers and Scientists, Vol. 37, No. 3, p 257-271, June, 1983. 7 Fig, 4 Tab, 16 Ref.

Descriptors: *Epoxy resins, *Water mains, *Linings, Microorganisms, Water conveyance.

The transition from laboratory-based trials to full-scale field applications of epoxy resin linings has highlighted problems with the consistent achievement of smooth, pinhole-free linings and the enhancement of non-pathogenic microbial activity in supply. Advancements in both equipment and materials have improved the quality of linings. However, further progress is required consistently to achieve the recommended 1 mm lining thickness. Changes to the epoxy resin formulations have resulted in materials which perform exceptionally well in the National Water Council (NWC) Approvals Scheme. The effect of these changes in supply has not resulted in the eradication of microbial activity, but a reduction in its duration. Recent investigations suggest that the increases are caused by system disruption during renovation and not the lining materials themselves. Work is in progress to assess the durability of these materials and to develop a comprehensive operational guideline manual which will provide the necessary information for the successful implementation of renovation programs using the epoxy resin lining process. (Author's abstract)
W84-01078

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East Bay Municipal Utility District, Oakland, CA.
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